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Geological Survey

R. W. BROCK, Director

Victoria Memorial Museum

BULLETIN No. 1 OCTOBER 23, 1913

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Canada
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BULLETIN No. 1

I.—The Trenton Crinoid, Ottawacrinus *W. R. Billings.*

By F. A. Bather, D.Sc., F.R.S., British Museum
(Nat. Hist.)

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HISTORICAL INTRODUCTION.

In 1887 Mr. Walter R. Billings (*Ottawa Natural.* I, p. 49 and pl.) founded the new genus *Ottawacrinus*, with the single species *O. typus*, based on a unique specimen collected by him in the Trenton formation at Hull, Que.

Mr. Billings considered his genus to be "most nearly related to Dendrocrinus."

In a paper on "the classification of the Inadunata Fistulata" (1890, "Brit. Foss. Crin.," *Ann. Mag. Nat. Hist.*, ser. 6, vol. V, pp. 329, 332, 334, 379, 380, 383, 384) I discussed the structure and relations of *Ottawacrinus*, placing it near *Merocrinus* and *Dendrocrinus*, but suggesting that it might, none the less, have given rise to *Cyathocrinus.* My remarks were based on the description by Mr. Billings.

Subsequently Mr. Billings was so very kind as to entrust me with the unique holotype for study, and this raised in my mind some doubts, which were hinted at in "The Crinoidea of Gotland" (1893, *Svenska Vet.-Akad. Handl.* XXV, No.2. See p. 101), and given further expression in "A Treatise on Zoology," Part III (1900, London. See pp. 112, 178). These doubts, however, did not affect the systematic position of the genus, which was left with *Merocrinus*, *Dendrocrinus*, *Homocrinus*, and *Thenarocrinus*, in a freshly diagnosed Family, Dendrocrinidæ.

At last I have devoted some time to the further preparation and study of the original material, and I find so many small details in which the very clear description by Mr. Billings can be supplemented or slightly emended that it seems well to publish an entirely fresh description. All deviations from the previous account are made with intention, after careful consideration.

TERMINOLOGY.

The terms and symbols employed in the description and diagrams are, for the most part, those used in my papers on British Fossil Crinoids, and are explained in "A Treatise on Zoology, Part III" (1900). IBB = Infrabasals; BB = Basals; RR = Radials; R*i* = Inferradial; R*s* = Superradial; RA = Radianal; *x* = proximal anal plate; Br = Brachials; IBr = Primibrachs; IAx = Primaxil; r. = right; l. = left; ant. = anterior; post. or p. = posterior.

Various terms in the description of the stem are used as defined in "Triassic Echinoderms of Bakony" (Budapest, 1909).

DESCRIPTION OF THE HOLOTYPE.

The Cup (Plate I, figs. 1, 2) in outer form merges equably into the stem below and the arms above, expanding from $\frac{3\cdot6+2\cdot8}{2}$ = 3·2 mm.[1] below, to $\frac{4\cdot8+3}{2}$ = 3·9 mm. above (at top of R*s*). The height, measured along the slope, from the stem to the top of R*s*, is 6 mm. in r. post. ray, 5·6 mm. in ant. ray and in l. post. ray; but measured to top of R*i*, it is 4·5 mm. in r. post. ray, 4·1 mm. in ant. ray, 4·2 mm. in l. post. ray.

IBB (Plate I, figs. 1, 2, 3) 5, hexagonal, alternating with the proximal pentameres of the stem. The lower angle is more obtuse than the upper. The l.ant.IB has a height of 1·7 mm.; width above, 2·2 mm.; width below, about 2·1 mm.

---

[1] This mode of expression gives the actual extreme measurements in the compressed fossil, and then the mean.

BB (Plate I, figs. 1, 2, 3) 5, vary in size; height of l. post. is 2·3 mm.; width above, 2·1 mm. This is the larger of the two normally hexagonal basals. Post. B is heptagonal, because it supports *x*. Right ant. B. is heptagonal, because not only does it support r. ant. R, but stretches between that radial and r. post. B, so as to meet the lower slope of r. post. R. Thus r. post. B. becomes small and pentagonal.

RR (Plate I, figs. 1, 2, 3) 5, all transversely bisected into R*s* and R*i*. Three of the inferradials, viz., ant., l. ant., and l. post., are of the usual pentagonal shield shape; but r. post. R*i* is hexagonal, resting on r. post. B, abutting by its two left sides on post. B and *x*, supporting r. post. R*s*, abutting by its long upper right side on r. ant. R*i* and a small portion of r. ant. R*s*, and by its short lower right side on the shoulder of r. ant. B; and r. ant. R*i* is four-sided, resting by a curved lower margin on r. ant. B, abutting on r. post. R*i* and ant. R*i*, and widening upwards to support r. ant. R*s*. All the superradials are four-sided, except r. post. R*s*, which abuts on *x* and *rt*, and perhaps one should add r. ant. R*s*, which has its lower left corner cut off where it abuts on r. post. R*i*.

The union of each R*s* with its R*i* is close, but the suture is perfectly clear. In no ray have the processes of decay or fossilization led to any dislocation of the two halves of the radial. In l. post., l. ant., and ant. rays there is a very gentle and equable tapering from the lower part of the inferradial to the top of the superradial. This is most obvious in l. post ray, where it is seen to be connected with the intercalation of the anal plates. In r. ant. ray the inferradial widens upwards slightly, and the superradial continues at about the same width. In r. post. ray the relations of width are disturbed by the anal plates, with which the halves of the radial alternate. In no ray is the base of R*s* less wide than the top of R*i*.

THE BRACHIALS preserved in association with the cup (Plate I, figs. 1, 2) are 3 IBr in every ray except r. post., where there are 4, and in r. ant., where a small portion of a fourth remains. There are also two separate fragments: one, a small piece of shale which includes some more distal brachials (Plate I, fig. 5), the other an isolated portion of an arm (Plate I, fig. 4).

The proximal brachials continue more markedly the tapering observed in some of the radials, the only exception being r. post. IBr_1, which interlocks with the anals. The bases of the first primibrachs are as wide as the tops of the superradials, but the line of union is very clearly marked, and in the three anterior rays is emphasized by a slight dislocation, especially visible in r. ant. ray.

The heights of the IBr. in l. ant. ray are (1) 1·1 mm., (2) 1·1 mm., (3) 1·0 mm. In section these proximal brachials are subcylindrical with a wide V-shaped ventral groove.

Arms non-pinnulate, regularly dichotomous. This is shown in the isolated arm-fragment and in one of the fragments in the shale. The position of the first axillare is uncertain, but it cannot be more proximal than IBr_4. How many times the arms forked is unknown; but the relative size of the isolated arm-fragment shows that its axillare is not a primaxil, so that there were at least two bifurcations. Each axillare widens gently towards its distal end, and the brachials immediately succeeding it abut by their inner sides. The general character of arm-branching is that of *Heterocrinus*. No features can be detected on the joint-faces of any of the brachials.

Cover-plates cannot be seen very clearly; but there appear to be some preserved, though somewhat pressed into the ventral groove, in the bifurcating portion of arm comprised in the shale-fragment (Plate I, fig. 5.) There are about three pairs to every two brachials. They alternate, and there seems to be a slight imbrication suggesting that their free or admedian ends are directed towards the proximal end of the arm.

Anal Structures (Plate I, figs. 1, 2, 3, 5). The proximal anal plate (x) rests on the narrow top of post. B, the suture being about 1 mm. long and curved downwards. The lower right side of x rests on the upper shoulder of RA, and its upper right side abuts on r. post. R [R*s*]. The left side of x bears a similar relation to the lower and upper halves of l. post. R, but is continuous in a straight line. Above, x supports two anal plates (*rt.* and *lt.*) of which that on the right is the wider, at least so far as can be seen, and is united to it by a suture 1·2 mm. long, with a slight downward curve. Anal x, therefore, though abutting on seven plates, is to all appearance six-sided.

Of the two plates resting on x, that on the right (*rt.*) abuts on the shoulder of r. post. R*s*, and on almost the whole of the left side of r. post. IBr_1. Above, it supports the right lower side of a large plate. On the left it abuts on the other of the two plates (*lt.*) It abuts, then, on five plates and is five-sided.

The fellow plate on the left (*lt.*) rests on x with a similarly curved lower margin, abuts on *rt.* with its side, and on two plates above with its two upper slopes. Its left side rests against a part of l. post. R*s*, and the whole of its ensuing brachial; but the plate curves inwards, and the line of junction with those ossicles is quite straight, so it may be that the actual margins of the plate are covered by the l. post. arm. Therefore, though the visible portion of the plate is five-sided, the whole may perhaps have been six-sided.

Resting above *rt.* and *lt.*, in the angle between them, is an irregularly hexagonal plate, 1·5 mm. wide, and of about the same height. Its right side abuts on r. post. IBr_2, but a very small portion of its lower corner rests on IBr_1, and, if counted, would make the plate heptagonal. Above, it supports two plates, and its left side abuts on a plate which may have been hexagonal, but of which only three sides are seen.

Five more plates of the anal tube are exposed on the outer surface of the fragment associated with the cup (Plate I, figs. 1, 2.) They form part of three horizontal rows, but are irregular in size, shape, and arrangement.

On the fragment comprising the cup it is not possible to see the plates that form the inner side of the tube. The shale fragment, however, contains at least three vertical series of plates, which probably belonged to the anal tube (Plate I, fig. 5). They are much lower and thinner than the associated brachials, and do not seem so closely united at the sutures. Their joint-faces seem to be bevelled towards the lumen of the tube, and this would have given the plates increased power of motion on one another. It appears, therefore, that the tube widened out a little distally, and that its skeleton was rather loose and flexible.

The relations of the anal tube to the adjacent arms are of some importance. On the left, the tube-plates seem to bend round and inwards, so as to be quite independent of the adjoining R*s* and brachials, the outline of which is unaffected by them. On the right, the tube-plates abut against the brachials and R*s* in such a way as to affect their outline, and to present the appearance of a sutural union with them, at least up to IBr_2, if no further. It may also be more than a coincidence that the anal tube and the r. post. arm are broken off at the same level, whereas all the other arms are broken off at another, lower, level. All these facts are of a piece with others to which I have more than once directed attention, as indicating an intimate connexion between the anal tube and the r. post. arm in Inadunata.

ORNAMENT. The surface of the cup-plates is smooth to the naked eye; but in places there is a suggestion of granulation here and on the lower brachials.

THE STEM is not wholly preserved, "as some pieces aggregating several inches in length were lost subsequent to the collection of the specimen. The aggregate length of column preserved is nearly ten inches" (W. R. Billings). Considering the small size of the cup, this length of stem, not less than 35 cm., is indeed remarkable.

The stem is quinquepartite throughout, with radial sutures. The lumen is pentagonal, with radial angles; its diameter is about one-third that of the stem, being rather more than this in the proximal (Plate I, fig. 8) and distal (Plate I, fig. 7) regions, and rather less in the median region (Plate I, fig. 6).

At its junction with the cup the diameter of the stem is $\frac{3\cdot6+2\cdot8}{2}=3\cdot2$ mm. A length of 5·4 mm. is still attached to the cup (Plate I, figs. 1, 2) and the diameter of the distal end of this is $\frac{2\cdot8+2\cdot3}{2}=2\cdot55$ mm. Within this length are 27 columnals. These alternate in height with fair regularity, owing, it is probable, to the intercalation and growth of young columnals throughout this proximal region. The respective heights of high and low columnals may be estimated at 0·26 mm. and 0·13 mm. Each pentamere is slightly curved upwards, so as to accord with the re-entrant angle between the IBB; this produces a wavy appearance. Since the pentameres of the thinner columnals thin towards their edges, this arching is gradually counteracted in the more distal regions. The sutures are strongly crenelate.

The fragments of the remainder of the stem show that it continued to taper until it reached a mean diameter of about 2·2 mm. This was probably at a distance of about 15 mm. from the cup. After that, the stem gradually increased in diameter, until at a few millimetres above the root the mean diameter is 4·3 mm., and 4·1 mm. immediately above the branching of the root.

Near the root the stem is slightly quinquelobate, the lobes corresponding with the pentameres. The section at the broken end of the fragment attached to the cup is neither circular nor sub-circular, but clearly subpentagonal, the convexities corresponding with the pentameres (Plate I, fig. 8.)

Just above the root the average height of a pentamere is 0·45 mm. In a region where the mean diameter is 3·35, the average height of a pentamere is 0·58. In this region, however, the pentameres alternate in thickness.

Even in the distal region the pentameres of one vertical section do not alternate or interlock quite evenly with those of the adjacent sections, but one of the end-slopes of each pentamere is shorter than the other. In the region where the pentameres alternate in thickness, the relations of the sections are still less regular, for a thick pentamere may abut at one or both of its ends on one thin and two thick pentameres of the adjacent section, so that its outline is 7- or 8-sided instead of 6-sided. This is shown in the enlarged figure of a suture by Billings (1887) and in our fig. 9 (Plate I). Thus the centres of adjacent pentameres come to lie at the same level, and the transition to regularly abutting pentameres of equal size is easy.

In the distal region the upper and lower joint-faces of the pentameres are marked with striæ formed of concresced granules (Plate I, fig. 7). The striæ radiate towards the periphery, branching slightly as they go. The same arrangement is visible in the middle region. Nearer the cup the striæ become coarser and change into distinct ridges (Plate I, fig. 6). These ridges then shorten at their adcentral ends, especially near the middle line of each pentamere, so that there is left a smooth or faintly granular area of rather indistinct petaloid shape. This area increases at the expense of the ridges as the cup is approached, and on the under joint-face of each pentamere it seems occasionally to swell up slightly, so as to fit into a corresponding depression on the upper face of the pentamere below.

The Root is said by Billings to have "identically the appearance of the radix figured as that of *Rhodocrinus asperatus*" (Canad. Org. Rem., Decade IV, pl. i, f. 4 *c-d*; 1859). The following differences from that figure, however, are to be noted. The lumen is not nearly so wide. The root-branches do not appear so suddenly or decidedly. The vertical series of pentameres are not observed to split so that half of one joins with half of another to form a rootlet. On the contrary only two divisions of the root can be seen, after prolonged preparation, and each of these is composed of two whole vertical series of pentameres. What happens to the fifth series is uncertain. The appearance is as though the distal end of the stem had been pressed so as to split it apart along two or three of the vertical sutures. The two root-branches cannot be traced to their ends, and their structure cannot be ascertained; but a broken section across one seems to show that it was tripartite, and that the lumen was relatively much smaller than that of the stem.

GENERAL CONCLUSIONS.

The chief alteration of view to which this renewed study has led me relates to the Radials.

Mr. Billings (1887) regarded all the radials as simple, except the right posterior, which he described as compound.

In "British Fossil Crinoids, II" (April, 1890, *Ann. Mag. Nat. Hist.*, p. 334 and pl. xiv) I suggested a "far simpler and equally probable" interpretation of the second plate in the r. post. ray, as homologous with the four other plates on a level with it and generally resembling it in form. That is to say, accepting the ideas of Mr. Billings as to the radials and brachials of all the other rays, I regarded the first or lowest plate of the r. post. ray as homologous with the radials, and the second plate as homologous with the proximal brachials. In 1900 ("Treatise on Zoology," III, Echinoderma, p. 178) I repeated the analysis originally based on that of Mr. Billings, as well as the above suggestion; but, having by then had the privilege of seeing the holotype, I was a little more cautious.

Now, as in 1890, I consider that the first and second plates of the r. post. ray are homologous with the plates corresponding to them in position in the four other rays. But in each ray those plates now seem to me to be the upper and lower half of a compound radial (R*s* and R*i*). This view is based on facts which were not fully apparent before the specimen itself was cleaned and examined. First, the upper plates are quite as wide as the lower at the line of junction. Secondly, the union of the two plates along the suture just mentioned seems to be closer than the union along the suture immediately succeeding. In these respects the right-hand of Mr. Billings' two drawings of the crown and my own previous analysis convey a false impression. Thirdly, the upward tapering of the plates here regarded as IBr_1, is in most rays more rapid than that affecting the plates regarded as R*s* and R*i*.

If, then, the present interpretation be correct, the two proximal elements of r. post. ray are, as in so many allied genera, the Radial proper (derived from R*s*) and the Radianal (derived from R*i*). The peculiarity of the interpretation lies in the view that all the other radials are horizontally bisected.

The interpretation of the radials here adopted has an important bearing on crinoid morphology. In 1900 ("Treatise on Zoology," III, Echinoderma, p. 112) I quoted *Ottawacrinus* as a Dicyclic genus in which some of the radials had been shifted so as to lie almost vertically above the basals; and I continued: "The suggestion then is that the inferradials and basals of Monocyclica represent basals and infrabasals respectively of Dicyclica. If then the R*s* and the R*i* fuse, a truly monocyclic type is produced with one circlet of BB and one of RR. One obvious objection to this theory is the presence in many Dicyclica of a plate (the radianal, RA), which is now generally regarded as a slightly modified inferradial." In putting forward that hypothesis as a possibility, I had in mind evidence other than *Ottawacrinus*, long since submitted to me by a foreign colleague, but not yet published by him. Now, so far as *Ottawacrinus* is concerned, it not merely ceases to be evidence for the hypothesis, but becomes the strongest evidence against it. If it be the case that inferradials coexist in this genus with basals and infrabasals, it is obvious that they cannot be homologous with basals.

It has been suggested to me that *Ottawacrinus* may have some connexion with the Flexibilia Impinnata. The somewhat close lateral abutment of the proximal brachials as well as of the brachials immediately succeeding an axillare (Plate I, fig. 4) lends some colour to this suggestion. On the other hand such arm-structure is quite common among Dicyclica Inadunata. The sutures between the brachials of *Ottawacrinus* are not curved as they so generally are in the Flexibilia. Further, its anal tube is far more reminiscent of the Inadunata, especially of the so-called Fistulata, than of any member of the Flexibilia. The stem is like that of many other Inadunata, and has no persistent proximale. On this last feature, however, no stress should be laid, for a proximale is, I understand, no longer regarded as diagnostic of Flexibilia by the survivor of the two authorities who had previously maintained it. It is a matter on which I was always sceptical (see *Geol. Mag.*, July, 1898, p. 324). There is in *Ottawacrinus* a slight widening of the stem towards the cup, but, since this amounts to no more than 0·7 mm. in a diameter of 3·2 mm. and in a length of 5·4 mm., it is scarcely enough to constitute a proximal cone such as is so common in Flexibilia. Turning to the cup we observe no structures that may not be as readily paralleled in Dicyclica Inadunata as in Flexibilia; indeed, more so, for the presence of five distinct infrabasals is quite foreign to the Flexibilia.

On the whole, then, there appear no good grounds for associating *Ottawacrinus* with the Flexibilia, although it would be difficult to deny that the early Flexibilia may possibly have originated from *Ottawacrinus* and allied genera. It is not easy to draw a line between the Flexibilia Impinnata and the Dicyclica Inadunata. But apart from that speculation, neither the new interpretation suggested in the present paper nor the additional facts brought to light involve any change in the systematic position of *Ottawacrinus.* Indeed, the view taken in the "Treatise on Zoology" (p. 178) is confirmed by the discovery of the arm-dichotomy and the structure of the anal tube. Retaining the Order Dicyclica Inadunata, Sub-Order Dendrocrinoidea, and Family Dendrocrinidae, as defined in that book, we may give the following:—

Diagnosis of Ottawacrinus.—A Dendrocrinid with 5 IBB; with all RR transversely bisected, with r. post. and r. ant. R*i* resting directly on the corresponding BB; with anal x resting directly on post. B, and supporting two tube-plates.

Canada
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BULLETIN No. 1

II.—*Note on Merocrinus Walcott.*

By F. A. Bather, D.Sc., F.R.S., British Museum (Nat. Hist.)

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Perhaps the interpretation of *Ottawacrinus* proposed in the preceding paper may be extended to the allied genus *Merocrinus* and its Monocyclic isomorph *Iocrinus*. I have always been dissatisfied with the usual interpretation of those genera. If in them the gabled plate supporting the anal tube be not a brachial (and few have been found to admit this as a possible interpretation), then it must be the superradial; but this makes the r. post. R very different from all the other radials, and in quite an unusual way. If, however, the elements in the four other rays, usually regarded as IBr_1, were really R*s*, then all the radials would have the same composition, just as they have in *Ottawacrinus*. It would then no longer be said (as in "Treaties on Zoology, Echinoderma," p. 179) "These two genera [*Merocrinus* and *Ottawacrinus*] suggest that RA of Dicyclica may not be strictly homologous with RA of Monocyclica."

The interpretation here suggested would result in the following—

Diagnosis of Merocrinus Walcott.—A Dendrocrinid with 5 IBB; with RR transversely bisected, and all R*i* equal in size and shape and alternating with BB; with anal *x* resting on the left shoulder of r. post. R*s*, and supporting a median series of plates.

This may be compared with the diagram given in the "Treatise on Zoology," vol. III (1900) on p. 178. I regret to find that, on the page in question, the diagram of *Merocrinus* has been interchanged with that of *Dendrocrinus*.

It must, however, be admitted that there are difficulties in this new interpretation. One species at least of *Merocrinus* (*M. salopiæ* Bather[1]) shows considerable differences between the first and second plates of the radial series, leading one to regard them as radials and brachials rather than as inferradials and superradials. Perhaps there is not so fundamental a distinction between radials and brachials as P. H. Carpenter believed.

The originals of the specimens described in my paper on *Merocrinus salopiæ* (loc. cit.) have now come into the British Museum, with the rest of the G. H. Morton collection. The holotype of *Merocrinus salopiæ* is registered E 14938; and the undetermined crinoid represented in fig. B of that paper is registered E 14939.

In the same paper, at the foot of p. 73, *Merocrinus curtus* (Ulrich) was said to have simple armlets. That was the natural interpretation of the phrase used in Ulrich's description (1879); but the species probably has regularly dichotomous simple arms like all others of the genus.

NOTE ADDED JULY 24, 1912.—These two papers were written in the spring of 1910, and the manuscript sent to Ottawa on July 15 of that year. On June 6, 1911, I received from Mr. Frank Springer a copy of his memoir "On a Trenton Echinoderm Fauna at Kirkfield, Ontario," issued by the Geological Survey, Canada, as "Memoir No. 15-P," and bearing the date 1911. Mr. Springer's "Letter of Transmittal" was dated June 28, 1910. That memoir contains an account, with beautiful drawings, of three specimens referred to *Ottawacrinus typus* and three referred to a new species, *O. billingsi*.

Had I been aware of Mr. Springer's work, it is probable that the present papers would never have been written. Even after they were written and the drawings prepared, I should have sought to withdraw them from publication had I anticipated this delay of more than two years. Further, the differences between my account and that of Mr. Springer, based on far richer and better material, might well have led to the complete rehandling of my description and speculations.

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[1] Feb. 1896, Geol. Mag., dec. 4, vol. 3, p. 71.

It has, however, seemed advisable to print the papers precisely as the manuscript left my hands. There will always be some value in the exact description of a type-specimen. Moreover the divergencies between our two accounts seem to require some explanation other than the better preservation of Mr. Springer's material. The chief of them are the following.

The arm-branching is described by Mr. Springer as heterotomous. This is clearly the case in his fig. 5, but it is not quite so obvious in his fig. 6. Fragments from the latter specimen might have appeared as regularly dichotomous as the fragments before me. Therefore I am prepared to admit that there may have been slight heterotomy in the holotype. In *O. billingsi* the heterotomy is strongly marked, and, as Mr. Springer says, quite peculiar.

"The ventral sac," writes Mr. Springer, "is composed throughout of irregularly hexagonal pieces without any longitudinal arrangement." This statement agrees with his fig. 6 but does not appear to be consistent with his fig. 7, which in this respect is closer to the holotype. It is indeed quite inconceivable that the holotype can have had a ventral sac like that shown in Mr. Springer's fig. 6. The fragment shown in my fig. 5 may be open to some slight doubt, but its structure is consistent with that of the main specimen (Plate I, fig. 1) and is quite different from that described by Mr. Springer.

Finally, Mr. Springer lays stress on the presence of "distinct plates in the axils between the rays. This is not entirely constant in *O. typus*, but is observable in the majority of the specimens." Such a plate is shown in his fig. 5. In the holotype, at any rate, there are no such plates, and the arms are so closely fitted in the proximal region that one finds it difficult to imagine the appearance of any interbrachials, except, of course, in the anal interradius.

So much for the differences of description. But examination of Mr. Springer's admirable figures brings to light other differences. Thus the proximal region of the stem has not the curious wavy structure indicated in my figures 1 and 2. Similarly the infrabasals have a pentagonal and not a hexagonal outline. The cup seems to widen upwards more rapidly than in the holotype, and to have more swollen plates. The axillaries are drawn as though relatively larger and more nodose than in the holotype. The stem of *O. typus* is not described by Mr. Springer, but that of *O. billingsi*, which he seems to regard as similar, differs in many respects from that of *O. typus* holotype.

All these differences lead to the conclusion that the specimens referred by Mr. Springer to *O. typus* really belong to a new species, and I much regret that I should have been the cause of his not having the holotype at hand for comparison.

Whether his two species belong to *Ottawacrinus* at all is a question that might be raised. If they do, then my present interpretation of that genus will not hold. But more than any of the precise differences noted above do the Kirkfield specimens seem to present a difference in the relation of the arms to the cup, in that the limit between the two structures clearly falls at the top of the plates which Mr. Springer calls radials, but which in the present paper are termed inferradials.

This is the point that makes all these minutiæ of description worth while. Have we in *Ottawacrinus* a form, or a series of forms, teaching us that in the earlier Inadunate Crinoids there was no fundamental morphological distinction between radials and brachials, and that the horizontal suture between superradials and inferradials was of the same nature as the joint between the superradial and the proximal brachial? This conception, however revolutionary it may sound, would be consistent with that view as to the origin of Crinoid brachia to which I was led by a study of *Hybocystis* (1900 "Treatise on Zoology" III, pp. 95, 96); and in connexion with a species of that genus I hope before long to revert to it.

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BULLETIN No. 1

III.—*The Occurrence of Helodont Teeth at Roche Miette and Vicinity, Alberta.*

By Lawrence M. Lambe.

With the invertebrate fossils collected during the past summer by Mr. D. B. Dowling, of the Geological Survey, and his party, from the limestone bed at the summit of Roche Miette, Alberta, is a small, detached fish tooth which is of interest.

Roche Miette is a noted landmark near Jasper lake, Athabaska river, in the second range of the Rocky mountains, 30 miles northeast of Yellowhead pass. The Grand Trunk Pacific railway passing to the north and west, touches the foot of this mountain, which rises to a height of about 7,700 feet above sea-level.

Other small collections of invertebrate fossils were made by Mr. Dowling at a number of points on the north side of Athabaska river, in a general direction to the north of Roche Miette. One of these includes a second fish tooth which, with the Roche Miette specimen, form the subject of the following remarks.

This other locality from which a fish tooth was obtained is on the eastern face of Bullrush mountain, near a small waterfall on a stream which runs through a deep ravine to Brulé lake. The fall is less than a mile from the lake, and is between 5 and 6 miles from Roche Miette.

According to Mr. Dowling the section studied by him in this area includes the lower part of the Cretaceous as its upper member, beneath which is a conformable series of limestones and shales of Jurassic, Triassic, Permian, Carboniferous, and Devonian age. Beneath this again are beds not as yet definitely determined as regards age, terminating below in a band of yellow sandstone and shale assigned to the middle Cambrian. The total thickness of the beds approximates 13,000 feet. The accompanying cut illustrates Mr. Dowling's present views regarding the succession of the members of this section, the asterisks indicating the two localities at which the fish remains occurred.

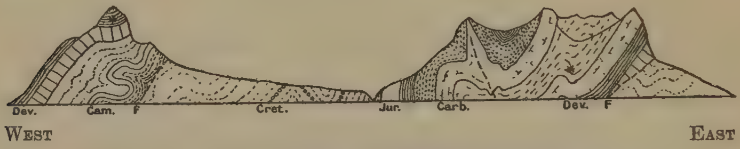

Fig. I.—Diagrammatic section through Roche Miette and Bullrush mountain.

The specimen from Roche Miette is a small, detached, anterior tooth referable to the genus Helodus, Agassiz, of the selachian family Cochliodontidæ. The specimen was embedded in bluish grey limestone holding many fragments of crinoid stems.

It is transversely elongated and arched, and appears to be somewhat worn (Plate II, figs. 1, 2, and 3.) The crown rises gradually to a well-defined rounded central prominence. On the side slopes the surface is rounded with a slight indication of angulation. On each side of the central prominence, midway between it and the lateral ends of the crown, and in the line of the angulation, is a faint elevation which might be more pronounced in an unworn tooth. One half of the crown is narrower than the other. The root in this specimen is broken off, but enough of its base remains in the concave lower surface to indicate that it was antero-posteriorly compressed and that its breadth about equalled that of the crown. The upper surface of the tooth is smooth and exhibits minute punctæ crossing the crown obliquely in moderately well-defined rows. There are about six punctæ in a space of 1 mm. in a row, and the rows themselves are a like distance apart. The long diameter of the tooth is 12·7 mm., at right angles to which it measures 4·6 mm. The maximum height of the crown beneath the central tubercle is 4 mm.

Helodus is an upper Devonian, Subcarboniferous, and Carboniferous genus, to which has been referred a number of detached, anterior teeth which have been given provisional specific names and which are generally regarded as belonging to Cochliodont sharks. It first appears, on this side of the Atlantic, in the Chemung (upper Devonian) of Pennsylvania, but is better known from over a dozen species from the Subcarboniferous of the central States (Iowa, Indiana, etc.) and is sparingly represented in the Coal Measures of Illinois. The genus was originally described from the Carboniferous of Great Britain, where the limestone series and the Coal Measures have furnished material for a number of species.

The Roche Miette specimen differs in form from hitherto described teeth referred to the genus Helodus. It distantly resembles *H. gibberulus*, Agassiz, from the Carboniferous limestone of Britain, a species which is recognized as having a Devono-Carboniferous range in the United States. The genus is new to Canada. In the Roche Miette tooth there are incipient lateral cones; in *H. gibberulus* these are highly developed. Small, polished, pitted teeth with a subsidiary tubercle on either side of a tumid, subconical, central dome, stated by Newberry[1] to be indistinguishable from *H. gibberulus* of the British Isles, occur in the Chemung and Waverly of Pennsylvania and in the Mountain Limestones of Illinois and Indiana

As the fish tooth from the summit of Roche Miette is apparently not referable to any described species of the genus to which it is considered to belong, and as this genus ranges from the Chemung up into the Coal Measures, there is no evidence supplied by the fish tooth in question as to the exact age of the rocks at the summit of Roche Miette, whether they are uppermost Devonian or belong to a higher horizon. The invertebrate fossils, however, which occurred with the fish tooth, have been studied by Dr. Percy Raymond of this Survey, who pronounces them to have a general upper Devonian aspect. This opinion, as to the age of the beds, is concurred in by Mr. Dowling on stratigraphical grounds.

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[1] The Palæozoic Fishes of North America, Vol. XVI, Monographs of the U.S. Geological Survey, 1889.

Mr. James McEvoy had previously, in 1898, collected a few invertebrate fossils from the same limestone beds, to which he assigned a Devonian age, relying on the determinations of Dr. J. F. Whiteaves[1].

The invertebrate fossils from Bullrush mountain near the waterfall are also, according to Dr. Raymond, indicative of an upper Devonian rather than a Carboniferous horizon.

For the fish tooth from Roche Miette the specific name *subtuberatus* is here proposed, the term having reference to the very small and inconspicuous swelling observed on either side of the central prominence of the crown

The second specimen to which reference has been made consists of a portion of a fish tooth labelled "Fall, north side of Athabaska river, Brulé lake, D. B. Dowling, 1911." The position of this locality has already been explained. The specimen is preserved in a piece of limestone similar to that of Roche Miette, and also holding numerous remains of crinoid rings in a like state of preservation.

This specimen (Plate II, fig. 4) is incomplete and formed part of a pavement tooth. The portion preserved is flat and four-sided with two rounded angles, one of the sides being the irregular line of fracture; it measures 9 mm. in length and breadth, with a maximum thickness where broken of less than 1 mm. The upper surface is smooth and polished, and, as in the Roche Miette tooth, minute punctæ or pores are present and similarly disposed. At the unbroken end the bony base projects beyond the margin of the upper polished surface as shown in the figure.

Traquair has shown that in the Cochliodont sharks there is a great variation, in both shape and size in individual teeth in a connected series, according to location. It is probable, therefore, that the tooth from the eastern slope of Bullrush mountain may belong to the same species as the one represented by the Roche Miette specimen.

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[1] See Mr. McEvoy's "Report on the Geology and Natural Resources of the country traversed by the Yellow Head Pass route," Annual Report, Geological Survey, Canada, Vol. XI, p. 29 D.

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BULLETIN No. 1

IV.—Notes on Cyclocystoides.

BY PERCY E. RAYMOND.

The recent discovery by the writer of a *Cyclocystoides* at so low a horizon as the lower part of the Lowville in Central Ontario, extends the known vertical range of this peculiar organism, and furnishes a text for a few observations upon the structure of the animal. It may be well first to review briefly the known occurrences of species of this genus, beginning with the oldest.

(1.) *Beatricea* beds of the lower Lowville, below the range of *Tetradium cellulosum*; 1 specimen, collected by the writer, on lot 25, con. VI, of Carden, Ontario. The specimen is about 15 mm. in diameter and is badly preserved. It seems to have had 30 plates in the sub-marginal ring. It is exposed from the upper side, but the plates of that side of the disk are entirely worn away, so that the plates of the opposite surface are exposed from the inner side. These plates are preserved in only a portion of the specimen, and show a radial arrangement of small plates with large pores between them. On one of the sub-marginal plates, the outer, excavated portion is retained, and shows two depressions to the plate. Some of the more weathered plates seem to show two pores which penetrate the plate longitudinally and connect the outer cup-shaped depressions with the inside of the disk.

(2.) Black River, Tetreauville, Que., near Ottawa. Mr. J. E. Narraway collected a slab showing the impressions of six rather small individuals. The specimens are too poor to furnish any information, but are important as indicating the presence of the genus in these strata. The Black River at Ottawa is believed to be of the age of the Leray in New York.

(3.) Crinoid beds at Ottawa. A number of specimens of *Cyclocystoides halli*, Billings, have been found at this horizon, but it is probable that the types came from the Cystid zone, higher in the section. The same species has been found at this horizon at Kirkfield, Ontario, and one of the specimens from that locality is described in more detail on a later page. The Crinoid zone at Ottawa includes the strata between 40 and 100 feet above the base of the Trenton.

(4.) *Prasopora* zone at Ottawa. So far as the writer knows, only a single specimen has been found at this horizon, and that is the one described later in this paper.

(5.) Cystid zone, Ottawa. A number of specimens, probably including the types of *Cyclocystoides halli*, have been found at this horizon. The Cystid zone at Ottawa includes all the strata between 75 and 150 feet below the top of the Trenton, and the *Prasopora* bed includes the 25 feet of strata below the Cystid bed.

(6.) In shaly strata near Saratoga, New York, Hall obtained the specimen which he described as *Cyclocystoides salteri*. His specimen is about 18 mm. in diameter, has 26 sub-marginal plates, and shows a border of minute plates outside the sub-marginal ring. It is exposed from the upper side, and seems to have weathered in such a way as to retain some of the features of both sides of the disk.

(7.) Upper part of the Trenton, or base of the "Hudson River" on the Escanaba river, Michigan. This locality yielded the very imperfect specimen to which Hall applied the name *C. anteceptus*. This specimen showed merely the sub-marginal ring of 29 plates.

(8.) The "upper part of the Cincinnati group" at Morrow, Ohio, furnished Miller and Dyer material (4 specimens) for describing the following species: *C. magnus*, 20 plates in the ring; *C. minus*, 19 plates; *C. parvus*, 26 plates; *C. mundulus*, 32 plates. They described a fifth species, *C. bellulus*, from a specimen found at Cincinnati. All these specimens were badly preserved, and the number of plates in the sub-marginal ring is relied upon to distinguish the species.

In a later paper Miller gave a better description of *C. magnus*, from a specimen found at Waynesville, Ohio. This specimen showed a system of radiating channels, two or three to a plate according to the size of the plate. This is one of the really important specimens, and will be mentioned again.

(9.) *Cyclocystoides nitidus*, Faber, is another of these so-called species, based on plates of the sub-marginal ring alone. It was found in the upper strata at Cincinnati.

(10.) *Cyclocystoides huronensis*, Billings, from the "Hudson River," at Rabbit island, Lake Huron, is based upon an interesting specimen, but was very inadequately described. It is discussed again on a later page.

Although 12 species have been described, the only specific differences so far pointed out are in the number of plates in the sub-marginal ring, all other supposed differences being in fact imperfections of the specimens. After handling a considerable number of specimens, the writer is still unable to point out anything on which specific descriptions can be based. Probably nothing satisfactory in that line will be accomplished until a large number of well preserved specimens have been collected. Of the specimens mentioned above, the types of Billings' *Cyclocystoides halli* are important as showing the structure of the sub-marginal ring; *C. salteri*, Hall, *C. magnus*, Miller and Dyer, and *C. huronensis*, Billings, show the upper side of the disk more or less perfectly, and I am now able to present illustrations of two more very good specimens, one showing the upper side of the disk in a very satisfactory manner, and one showing the opposite side very well.

CYCLOCYSTOIDES HALLI, BILLINGS.

Plate III, figs. 1, 3, and 4.

Cyclocystoides halli, Billings, 1858. Canadian Organic Remains, Decade 3, p. 86, pl. x *bis*, figures 1-7.

The best of the specimens which served as the types of this species is that illustrated in figs. 2 and 3 of Billings' plate x *bis*. This specimen is of especial value, as it shows the character of the plates of the sub-marginal ring, which are better preserved than on any other known specimen. The ring in this specimen is made up of wedge-shaped plates which are longer than wide. On the upper part of the specimen, the inner half of each plate, or slightly less than half, is solid and tuberculated, while the outer half, or a little more, is excavated, so that two spoon-shaped depressions are formed. Nearly the whole thickness of the shell is excavated, and the outer edge of the solid part of the plate is under-cut, as is shown in the side view of one of these plates. This under-cutting extends into the solid portion of the plate as a cone-shaped pit leading inward from each spoon-shaped basin, and there are probably pores through the plates, although the evidence on that point is not clear. The spoon-shaped basins, two to a plate, continue all around the outer side of the ring, and form a circular canal, which is covered with small plates. There are two series of these small plates. The first series consists of a row of small, curved plates which are nearly vertical, and form the outer wall of the canal. These plates frequently fall outward on the disintegration of the animal, and are then seen as an extra series of plates outside the sub-marginals. This condition is shown in the specimen of *C. huronensis*, and in Hall's figure of *C. salteri*.

The second series consists of a double row of very small, roughly pentagonal roofing plates, their outer ends somewhat pointed, and interlocking. They are arranged so that those of the inner and outer row alternate in position, and there are about 4 or 5 to a sub-marginal plate. These plates are very loosely attached, resting on the edges of the vertical outer plates on the outside, and in the groove formed by the undercut on the inside. They were probably movable. These plates were observed by Billings, and figured, although inaccurately.

The large plates of the sub-marginal ring are not set firmly against each other, but have a space between, and this space enlarges from the middle towards both upper and lower surfaces. The sides of the plates are vertically striated, as is shown in Billings', Hall's, and Miller's figures, and, as has already been suggested, these striations indicate cartilaginous or muscular attachments between the plates, giving considerable flexibility to the ring.

The specimen now being described preserves a few of the plates of the lower side, seen from the inside, showing their form and loose arrangement, but presents no other detail of the disk.

to be two very small plates in front of each sub-marginal plate. These small plates do not make a solid covering, but have large pores between them. Around the small mound which resembles an anal pyramid, there are five small, deep depressions, which may indicate the main trunks of the sinuses which extend beneath the integument, as has been described.

The great length of the plates of the sub-marginal ring on this side serves to distinguish the lower from the upper side of the animal.

This specimen was collected by Mr. J. E. Narraway, at the Axe Factory quarry, Hull, Que., and is from the *Prasopora* zone of the Trenton.

CYCLOCYSTOIDES HURONENSIS, BILLINGS.

Plate III, fig 2,

Cyclocystoides huronensis, Billings, 1865. Palæozoic Fossils of Canada, Vol. I, p. 393, fig. 369.

This species was briefly described and very inadequately figured by Billings. The specimen is a large one, considerably weathered, and is of interest as showing well the relation of the radial ridges of the dorsal side to the plates of the sub-marginal ring. Specifically, it is easily distinguished by the great number of small plates, about 60, in the sub-marginal ring, and its large size (35 mm. in diameter).

The sub-marginal plates differ from those of *C. halli*, in that some of them have only one, instead of two, spoon-shaped depressions on the outer half. Each plate has a narrow ridge leading to it, and these ridges unite as the centre is approached, but the system can not be made out as clearly as in the specimen of *C. halli* from Kirkfield. They evidently unite in some such manner, as only 5 branches reach the centre. At one point on the outside of the sub-marginal ring, the plates of the vertical series bounding the outer wall of the circular canal can be seen, where they have fallen outward. Outside of them, there is a narrow band which has somewhat the appearance of being made up of imbricating plates. This is the "shagreen" border of Hall's description, and suggests the outer border of *Agelacrinites billingsi*. Just what its relation to the animal was is not evident.

SUMMARY.

From the above descriptions, it appears that *Cyclocystoides* was a free and not a fixed or parasitic animal; that it consisted of a circle of strong wedge-shaped plates, the outer portions of which are excavated, so as to form a ring of spoon-shaped basins all around the animal; that this ring of basins was bounded on the outside by vertical, curved plates, and roofed by small, alternating, interlocking plates; and that the portion inside the ring was covered on one side by loosely arranged, irregular plates, while the other side was entirely covered with closely-fitting plates. The side with the small plates appears to have an aperture at the centre, while there is none on the opposite side. Outside the ring of strong plates there appears to be a border which is only partially calcified.

The figure and description of *C. salteri* by Hall are incorrect in that he considered the spoon-shaped depressions to be on a separate series of plates, and he did not recognize the character of the vertical outer plates of the covering series. The restored figure given by Bather adds to these the mistake of placing the larger plates on the lower instead of the upper side.

INTERPRETATION.

Throughout this paper, the writer has followed the usual habit of regarding this as an animal, complete in itself. Viewed from this standpoint, the following interpretation of the structures is possible.

The animal was a free Cystidean or Edrioasteroid, with a strong but flexible ring of plates, within which was a body portion with a fairly rigid roofing of plates on one side and a partially calcified membrane on the other. The mouth is sub-tegminal, and the food was brought to it from the outer canal through arched channels, the outer canal collecting food from the water through the movable roofing plates. The anus is situated directly beneath the mouth, in the centre of the more membraneous side. The partially calcified ring outside the main ring of plates, might serve either as an organ for temporary fixation, or, possibly, in swimming.

The objections to this interpretation, although not insurmountable, are obvious and great. In the first place, no echinoderm is known in which the food groove is not radial, instead of circular, and does not lead directly to the mouth. In the second place, there does not seem to be any aperture for the discharge of the great amount of water which would be drawn into the body, for, were it discharged through the anal opening, there would be no opportunity for digestion. It is possible that a more complete specimen than has yet been found would explain this objection, so that it has not as much weight as the first one.

A second interpretation is, however, possible. The organism may be the highly specialized root of a free crinoid. At the centre of the disk of the specimen from Kirkfield, there is just the suggestion of a scar, as if a small stem might have been attached. There are many crinoid roots which show a method of bifurcation somewhat similar to the ridges shown on this and other specimens, and *Lichenocrinus*, at least, shows a root which is plated and which further has radial canals beneath the surface. Interpreted thus, *Cyclocystoides* would have been a sort of sucker-disk which, being flexible on the lower side, and having a flexible apron around it, could, by the expulsion and ingestion of water, make a partial vacuum, and thus attach or loosen itself at will. The so-called anal opening would then become an orifice for the expulsion of water. It is even possible, if one is sufficiently imaginative, to think of this disk as a swimming organ, the method of propulsion being on the same principle as in some of the cephalopods.

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BULLETIN No. 1

V.—*Notes on Some New and Old Trilobites in the Victoria Memorial Museum.*

By Percy E. Raymond.

Genus Eoharpes, Raymond.

Eoharpes dentoni, (Billings).

Plate III, fig. 5.

Harpes dentoni, Billings, 1863. Canadian Naturalist and Geologist, Vol. VIII, p. 36, fig. — 1865. Palæozoic Fossils Canada, Vol. I, p. 183, fig. 166.

This species was described by Billings from an incomplete cranidium. There is, however, in the collection, a complete but rather poorly preserved specimen of the same species which was collected by a late Director of the Survey, Dr. A. R. C. Selwyn, in 1880. This is the only entire specimen of an American *Harpes* of which the writer has knowledge.

There do not appear to be more than about 18 segments in the thorax, and possibly only 16, but the specimen is rather obscure in this region, and it is not possible to tell where the pygidium begins. The genal spines are narrow, and so long as to extend slightly beyond the pygidium. They are much longer and the brim is narrower than in *Eoharpes ottawaënesis* (see Plate III, fig. 6). In front of the glabella, the brim of *E. dentoni* is narrow, deeply concave, and the anterior rim is curved upward, while in *E. ottawaënsis* the brim at the front is wide and nearly flat. On the glabella, the pair of furrows in front of the posterior oblique pair are much stronger in both species than is indicated in the original figures.

A second specimen of this species was found on a tablet, labelled as *Dalmanites bebryx*. This shows the pygidium and some of the thoracic segments, but here, too, it is impossible to say how much is pygidium. Barrande states that there are three or four segments in the pygidium of *Harpes*, and this fragment exhibits 15 segments in all. It is from a much larger specimen than the one collected by Dr. Selwyn, and evidently when complete had more segments. The genal spines extend beyond the pygidium in this specimen also.

LOCALITY.—Ottawa, Ontario. Label reads "Ottawa River," and is, therefore, presumably from the Cystid zone of the Trenton.

GENUS BUMASTUS, MURCHISON.

BUMASTUS BILLINGSI, Raymond and Narraway.

Plate III, fig. 12.

Bumastus billingsi, Raymond and Narraway, 1908. Annals Carnegie Museum, Vol. IV, p. 250. Pl. LXI, figs. 1, 2.

In a collection of fossils, some of them unique, recently presented to the Survey by Sir James Grant, is a large and fairly complete specimen of this species. It shows very well a character not noticed in the original description, namely, the shortening of the pleura of the anterior thoracic segments. On the first four segments, the outer ends of the pleura are truncated, the first being the shortest, and each of the others slightly longer, until the fifth segment, which is normal, is reached. The truncated pleura are somewhat broader than the others, and more convex.

The free cheeks are not preserved in this specimen, nor were they in the types, but from the shortening of the pleura of the thoracic segments, it would appear that the genal angles were extended, as in *Bumastus limbatus* of the Chazy, into spines which reached at least as far back as the fifth segment of the thorax.

LOCALITY.—This specimen is No. 331, and is from the Trenton at Ottawa, Ont.

GENUS HOLASAPHUS, MATTHEW.

HOLASAPHUS MOOREI, SP. NOV.

Plate III, figs. 7, 8, 9, 10, and 11.

The genus *Holasaphus* was proposed by Dr. Matthew[1] to include a species with an asaphid-like pygidium which bore a terminal spine, and with a cranidium much like *Bathyurellus*. Dr. Matthew seems to place it in the Asaphidæ, but the writer hesitates to do so, at least until more perfect specimens are obtained. The discovery of a new species belonging to this genus, at a very different locality and horizon, is of considerable interest. The present species is represented by four or five more or less perfect pygidia, a portion of one cranidium, and two free cheeks. An associated hypostoma probably belongs with this material.

DESCRIPTION.

Glabella very low, oval in outline, surrounded by faint dorsal furrows. There are faint traces of two pairs of glabellar furrows. Neck ring wide, smooth, neck furrow narrow, shallow. Eye large, situated far back; fixed cheek narrow, grooved by the neck furrow. Facial suture curves outward from the eye to the anterior margin. Free cheek rather wide, low, with a slightly elevated border. The genal angle bears a spine which diverges widely from the axial line of the body.

Thorax unknown.

Pygidium convex, with a strongly convex axial lobe which rises high above the side lobes. The posterior end of the pygidium bears a short, sharp spine, which is an extension of the margin and not of the axial lobe. The pleural lobes have four pairs of ribs and the axial lobe four rings. There is a wide, depressed, but hardly concave border which is faintly marked by the ribs. The surface of the test is roughened by numerous fine, irregular impressed lines.

The associated hypostoma is one which strongly resembles the hypostoma of *Megalaspis*, and furnishes an argument in favour of admitting this genus to the family Asaphidæ. The body portion is strongly convex, and it is slightly constricted by two faint depressions at the posterior end. The border around the body portion is narrow, concave, and there are narrow extensions at the sides.

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[1] Transactions Royal Society Canada, 3rd series, Vol. I, p. 268.

Measurements.—The best pygidium, which may be taken as the holotype of the species, is 10 mm. long, and 11 mm. wide. Of this length, 2·5 mm. is due to the projection of the spine at the posterior end. A larger pygidium is 14 mm. wide, and, without the spine, 9·5 mm. long. The hypostoma is 7 mm. long and 6 mm. wide.

This species differs from *Holasaphus centropyge*, Matthew, in having the eye much farther back on the head, a longer and narrower fixed cheek, and a more divergent spine on the free cheek. The pygidium of our species has four distinct rings on the axial lobe, and that of Matthew's species only three.

Locality.—Specimens of this species seem to be fairly common in an old quarry in the lower part of the Beauharnois formation, (Beekmantown), near the Canadian Pacific Railway station at St. Anne de Bellevue, Island of Montreal, Que., where the first specimen was found by Mr. E. J. Whittaker. The name is given in allusion to the writing of the Canadian Boating Song by Tom Moore while staying at a house not far from this quarry.

GENUS PSEUDOSPHÆREXOCHUS, SCHMIDT.

PSEUDOSPHÆREXOCHUS APOLLO, (Billings).

Plate IV, figs. 1 and 2.

Cheirurus apollo, Billings, 1860. Canadian Naturalist and Geologist, Vol. V, p. 322, fig. 28.—Palæozoic Fossils of Canada, Vol. II, p. 413, fig. 397, 1865.

Amphion cayleyi, Billings, 1863. Geology of Canada, p. 239, fig. 277.—Palæozoic Fossils of Canada, Vol. I, p. 413, fig. 398.

"*Cheirurus*" *apollo* was described by Billings from an imperfect cranidium found at Point Levis. The collection contains a metal cast which is probably a replica of the type. On the same page of the 'Palæozoic Fossils" is the figure of a pygidium, which in the Geology of Canada, 1863, p. 239, was called *Amphion cayleyi*. Billings states, however, that this pygidium may belong to a species of "*Cheirurus*," perhaps to *C. apollo*, and this prediction seems to be verified by a couple of specimens collected at Point Levis in 1899 by the late T. C. Weston. One of these specimens is a cranidium of *P. apollo* with 12 thoracic segments, and the other is a large pygidium of *Amphion caleyi*. The anterior portion of the pygidium is so exactly similar to the thoracic segments of the *Pseudosphærexochus* as to leave no doubt that the two belong to the same species, though not to the same specimen.

DESCRIPTION.

Animal elongate oval, spinose, with prominent axial lobes. Cephalon semi-circular, dominated by the glabella, which is large and prominent, while the cheeks are small and depressed. Eyes small, well forward, opposite the second pair of glabellar furrows. No spines at the genal angles. The facial suture cuts the anterior margin close to the glabella, and back of the eye runs outward and a little backward, so that it cuts the margin again close to, but in front of, the genal angle. Free cheeks not seen. Fixed cheeks covered with large pits. Glabella raised high above the rest of the cephalon, but depressed on top. It tapers rapidly towards the front and is marked by three pairs of deep, narrow furrows, all of which turn a little backward at the inner ends. The surface of the glabella is granulose.

The thorax of this specimen has 12 segments, and it is doubtful if any are missing. The axial lobe is convex and narrow, standing high above the pleural lobes, which are flat, and divided by a deep, narrow groove into an anterior and posterior ridge, the hinder ridge being extended at the point of geniculation into a long sharp spine which turns upward and backward. At the geniculation, the pleura are bent abruptly downward, and end in blunt spines.

The pygidium is strongly spinose and is made of four segments, the first two of which are hardly different in form from those of the thorax. The third and fourth segments have the anterior ridge reduced in size, and the posterior ridge flattened. Between the posterior ridges of the last segment is a cuneiform plate which probably represents the original pygidium.

It will be noticed that this plate is much larger in the specimen here figured than in the smaller specimen figured by Billings.

Measurements.—The thorax and pygidium figured are 41 mm. long. Glabella 13 mm. long, 15 mm. wide. Cephalon about 26 mm. wide. The large pygidium is 22 mm. long (without spines), and about 45 mm. wide. The most perfect spine is 15 mm. long.

This species is similar to "*Cheirurus*" *vulcanus*, Billings, but has the eye farther forward and farther from the glabella, has a flatter and more prominent glabella, and last and more important, it has the suture cutting the margin in front of the genal angle, instead of at or behind it.

In "*Cheirurus*" *vulcanus* the suture is as shown in Billings' figure (Palæozoic Fossils, p. 284, fig. 271), and differs so widely from the proper suture in the *Cheiruridæ* as to make one doubt if this species belongs to that family. Furthermore, the pygidium which is associated with this form both at Cow head, Newfoundland, and Stanbridge, Quebec, is very different from that of either *Pseudosphærexochus* or *Neiszkowskia*. "*Cheirurus*" *prolificus*, Billings, which can hardly be separated from *C. vulcanus*, has the same type of suture, and so does *C. mercurius*, Billings.

GENUS CERATOCEPHALA, WARDER.

CERATOCEPHALA GONIATA, WARDER.

Ceratocephala goniata, Warder, 1838. American Journal of Science, Series 1, p. 373, fig. —Weller, 1907. Bulletin IV, pt. II, Chicago Academy of Sciences, p. 255, Pl. 23, figs. 1-2. Also full bibliography of the species on p. 191 of the same Bulletin.

This species has so far been reported only from a restricted area in the general region of Chicago, Illinois, and the writer was, therefore, rather surprised to find two typical specimens in the Museum, on a tablet with specimens labelled *Bronteus pompilius*, Billings.

One of the specimens was collected by Sir William Logan at Port Daniel, Chaleur bay, in 1843 and is probably the specimen referred to by him on page 54 of the "Report of Progress" for 1844 (Published 1846). After describing *Brontes* ? *canadensis*, of which the type is lost, but which was probably a Lichad, he says there is another *Bronteus* present (afterward described by Billings as *B. pompilius*) and adds: "The head of another trilobite armed with spines occurs."

A second specimen was collected in 1862 by Robert Bell at the Gros Morbe, in the same region. These specimens are of interest as showing the possible path of the migration of this species. The recent discovery by Mr. R. Harvie, of the Geological Survey, of a pygidium of *Bronteus pompilius* and a cranidium of a *Ceratocephala* like *C. goniata*, in dark Silurian shales at Knowlton Landing, Lake Memphremagog, Que., furnishes, perhaps, another link in the route of migration.

Canada
Geological Survey
Victoria Memorial Museum
BULLETIN No. 1

VI.—*Description of Some New Asaphidæ.*

By PERCY E. RAYMOND.

FAMILY ASAPHIDÆ, Emmrich.

SUB-FAMILY OGYGINÆ, Raymond.

GENUS HEMIGYRASPIS, Raymond.

HEMIGYRASPIS MCCONNELLI SP. NOV.

Plate IV, fig. 4.

This specimen was figured as *Hemigyraspis* sp. ind. in a recent paper in the Transactions of the Royal Society of Canada, Vol. V, 1912. The type is a fairly complete but distorted specimen, and the collection contains other fragments which are presumably of the same species.

DESCRIPTION.

Entire body broadly oval, cephalon and pygidium semicircular, general surface relatively smooth, axial lobe about one-third the total width, genal angles extended into long spines.

Cephalon nearly semicircular in outline, with a low obscurely defined glabella. Eyes of medium size for an asaphid, about their own length from the posterior margin.

Thorax of eight smooth segments which are pointed at their distal ends.

Pygidium semicircular in outline, depressed convex. On the type the axial lobe is very well defined,but that may be due to the crushing of the specimen.

Measurements.—The type, which is twisted as shown in the photograph, gives the following approximate measurements: total length, about 115 mm.; width about 70 mm.; length, cephalon, 40 mm.; width, axial lobe of thorax, 25 mm.; length, pygidium, 37 mm.; width, 70 mm.

Hitherto, two species of *Hemigyraspis* have been described from American deposits. One was described by Matthew[1] from the basal Ordovician of Cape Breton, as *Asaphellus* ? *planus*, and a second by the writer from the lowest fossiliferous zone in the Beekmantown at Bellefonte, Penna. (*Hemigyraspis collieana*)[2]. From both these, and from all known European species of the genus, the present specimen differs in the spinose terminations of the segments of the thorax.

Locality.—The specimens are from a locality 3 miles east of Golden, B.C., and were collected by Mr. R. G. McConnell in 1886.

SUB-FAMILY ASAPHINÆ, Raymond.

GENUS BASILICUS, Salter.

BASILICUS BARRANDI, Hall.

Asaphus barrandi, Hall, 1851. Report on Geology of the Lake Superior Land District (Foster and Whitney), pt. 11, p. 210. Pl. XXVII, figs. 1, a–d; Pl. XXVIII—1862: Geology Wisconsin, Vol. I, p. 41, fig. 4.

Asaphus wisconsensis, and romingeri Walcott 1879. Twenty-eighth Annual Report New York State Museum, p. 97.

Ptychopyge ulrichi, Clarke, 1897. Palæontology Minnesota, Vol. III, pt. 2, p. 709, figs. 12, 13.

Basilicus romingeri, Raymond and Narraway, 1910. Annals Carnegie Museum, Vol. VII, p. 49, pl. XVI, figs. 1–4.

This specific name seems to have been very successful in evading the eyes of describers of trilobites, and it was not until recently that the writer's curiosity to know what form it was which Vogdes referred to *Ogygia* (Catalogue of Trilobites, p. 324) caused him to unearth it.

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[1] Bulletin Natural History Society New Brunswick, Vol. IV, 1902, p. 419, Pl. 18, fig. 11.

[2] Annals Carnegie Museum, Vol. VII, 1910, p. 41, Pl. 16, figs. 9-13.

The species is well described and figured by Hall, and we have to accept the name. Whether or not it is entirely to supersede *Asaphus romingeri* is a question. The writer is unable to point out any very important differences between the eastern and western forms, except that the eastern specimens seem to be somewhat less convex. There are a few imperfect specimens of the western form in the Museum of the Geological Survey, Canada, two of the best of which are figured. The pygidium was collected at Gravel point, St. Joseph island, Lake Huron, by the late T. C. Weston, and the partial cranidium is from the "east side of St. Joseph island," and was also collected by Weston.

GENUS OGYGITES, TROMELIN AND LEBESCONTE.

OGYGITES CANADENSIS, Chapman.

Plate VI, fig. 1.

Cf. *Asaphus* ? *latimarginatus*, Hall, 1847, Palæontology New York, Vol. I, p. 253, Pl. 66, figs. 4 a–b.

Asaphus canadensis, Chapman, 1856. Canadian Journal, Vol. I, p. 482; Ibidem, Vol. II, 1858, p. 47; Ibidem, Vol. III, 1858, p. 230, fig.; Ibidem, Vol. IV, 1859, p. 1, fig. Annals and Magazine Natural History, 3d series, Vol. II, p. 9, fig. 1, 1859.

Asaphus halli, Chapman, 1859. Canadian Journal, Vol. III, p. 236, fig. Annals Magazine Natural History, 1859, series 3, Vol. II, p. 14, fig. 2.

Asaphus hinksii, Chapman, 1859. Canadian Journal, Vol. IV, p. 2, fig.

Basilicus canadensis, Raymond, 1910, Annals Carnegie Museum, Vol. VII, p. 62.

Ogygites canadensis, Raymond, 1912. Transactions Royal Society of Canada, series 4, Vol. V (in explanation of plates).

Mr. Elfric Drew Ingall, of the Geological Survey, was so fortunate this summer as to discover a very well preserved specimen of this species. The specimen is doubly interesting, for it is from a bed of limestone, so that, instead of being crushed flat, as usual, it retains its natural convexity, and further, it retains the cephalon in so good a state of preservation as to show the course of the facial suture. And this facial suture shows that the writer was in error in referring the species to *Basilicus*.

The name *Ogygites* will be an unfamiliar one, even to students of trilobites, for it has hardly been used since the time of its original publication, and I am indebted to Brig.-Gen. A. W. Vogdes for calling the name to my attention. It appears that Tromelin and Lebesconte[1] noted that the name *Ogygia* had been used by Hubner in 1816 for a genus of Lepidoptera, so that it was not available when applied to a trilobite by Brongniart in 1822. They, therefore, replaced it by *Ogygites*. But they also found, following a suggestion by Barrande, that the type-species of *Ogygia*, *O. guettardi*, Brongniart, had a forked hypostoma and the facial sutures meeting in a point on the upper surface of the cephalon. The discovery compels the exclusion of the *Ogygias* of England and Scandinavia, *O. buchii* and *O. dilatata*, from the genus, but fortunately they are taken care of by the name *Ogygiocaris*, proposed by Angelin, with *O. dilatata*, (Sars), as the type.

Ogygia, or, properly, *Ogygites*, as emended by Tromelin and Lebesconte from the study of Brongniart's type, includes trilobites which are very similar to *Basilicus*, Salter, but differ in having the facial sutures meeting in a point in front of the glabella, instead of running around the anterior margin.

The specimen recently found by Mr. Ingall shows that *Asaphus canadensis* has this type of suture. The crushed specimens previously collected did not show this point, and as the species has a strongly segmented pygidium, a narrow axial lobe, a definitely outlined glabella, and spines at the genal angles, the writer referred it to *Basilicus*.

Entire specimens of this species have hitherto, with rare exceptions, been found only at Collingwood, Ontario, but Mr. W. J. Wilson, assistant palæontologist to the Survey, found a number of very good specimens this season in a brown shale near the same horizon and locality as the specimen collected by Mr. Ingall.

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[1] Cat. raisonne Foss. Silur. Assoc. Fr. Avanc. Sc. Cong. Nantes, p. 631, 1876.

Locality.—The specimen figured was collected by Mr. Elfric Drew Ingall from a layer of limestone within 15 feet above the top of the Trenton on Adeline street, between Preston and Rochester streets, Ottawa, Ontario. The horizon is the lower part of the Collingwood formation, supposed to be of early Utica age. The specimen is No. 7817.

GENUS ISOTELUS, DEKAY

ISOTELUS LATUS, SP. NOV.

Plate 5.

In the Trenton at Ottawa there is a species of *Isotelus* which differs from *I. gigas* in having all its parts much wider. As the type I have selected the specimen figured in the Geology of Canada, 1863, p. 184, figure 183, as *Asaphus platycephalus*. This figure has been so frequently copied in text books, that the species, though new, has long been well known. Another well known specimen of this species is the one on which appendages were found by Billings.

DESCRIPTION.

Body oval in outline, a little more than one-half longer than wide, broadly rounded at both extremities. Dorsal surface relatively smooth, the axial lobe of the thorax wide, and the whole test less convex than in *I. gigas*. The test is punctate, and is marked by wavy, inosculating depressed lines.

Cephalon three-fourths as long as wide, regularly curved in front, depressed convex, dorsal furrows obsolete, thus leaving the glabella undefined. Eyes relatively small, far apart, situated more than their own length from the posterior margin of the cephalon. Genal angles rounded in the adult. Young unknown.

Pygidium shorter and more nearly semi-circular than the cephalon, smooth, with depressed border of medium width. Dorsal furrows obsolete, and axial lobe not defined.

The following are the principal measurements of the type:—

Length, 190 mm.; width, 120 mm.; width axial lobe of thorax, 50 mm.: length cephalon, 94 mm.; width, 120 mm.: eyes, length, 12 mm.; back of eye, 17 mm. from posterior margin of cephalon; distance between eyes, 50 mm.: pygidium, 70 mm. long; 115 mm. wide.

This species is readily distinguished from *I. gigas* by its broader and more rounded form, and its shorter and wider cephalon and pygidium. Local collectors in Ottawa have called this form *Asaphus platycephalus*, to distinguish it from the more triangular *Isotelus gigas*. The inadequate figures of Stokes' species, which was never described, prevent its positive identification, and the name will have to be dropped. The Museum of the Geological Survey contains a number of specimens of *Isotelus* from St. Joseph island, but none of the size of the one described by Stokes. The specimens which we have are all *Isotelus gigas*, and the presumption is that Stokes' specimens were of that species also. Even with the types, the point could hardly be definitely decided, so, as just remarked, it is much better to drop Stokes' name.

Locality.—This species is rather common at Ottawa in the cherty layers of the Crinoid zone, and less so in the *Prasopora* and Cystid zones of the Trenton. The exact locality from which the type was obtained is not known. On the tablet in the Museum it is marked "Trenton, Ottawa, Ont., J. McMullen, collector." The Museum number is 1788.

ISOTELUS MAXIMUS, LOCKE.

Plate IV, fig. 8.

Isotelus maximus, Locke, 1838. Second Annual Report Geological Survey of Ohio, p. 246, figs. 8, 9.

Isotelus megistos, Locke, 1841. Transactions American Association of Geologists and Naturalists, p. 221, Pl. 6.

Isotelus and *Asaphus megistos* of authors.

A small specimen of this species collected from the Lorraine at Hawthorne, near Ottawa, Ont., by the writer, is figured, to show the great length of the genal spines in a young specimen of this species.

The species seems to be somewhat common in the Lorraine at Toronto, and through the courtesy of Dr. W. A. Parks, the writer was permitted to study the series of very fine specimens in the Museum of the University of Toronto. Many of the specimens are very large. The largest complete specimen is 285 mm. (nearly one foot) long, but there is another incomplete specimen whose measurements are all 10 per cent greater.

All the specimens which were well enough preserved show spines at the genal angles of the cephalon. The spines are somewhat longer in the smaller specimens, but as they are usually imperfectly preserved, no very satisfactory measurements could be made.

On a specimen 145 mm. long, the spines were 17 mm. long; on another, 171 mm. long, the spines were 31 mm. long; and on one 187 mm. long, the spines were 16 mm. long. The width of the axial lobe, in relation to the total width of the thorax at the back of the fourth segment, was measured in 15 specimens, and it was found that this ratio varied from 0·34 to 0·40, but that most of the specimens were near 0·37 and 0·38. As the writer has already pointed out, following various other writers, there is no real reason why this species should be confused with *Isotelus gigas*, the cephalon and pygidium always being shorter and wider, more rounded in outline, the axial lobe narrower, and genal spines being present in adults.

GENUS BRACHYASPIS, SALTER.

BRACHYASPIS ALTILIS, Raymond.

Plate IV, figs. 3 and 7.

This name was proposed without a formal description, in a paper on "Parallelism among the Asaphidæ" in the Transactions of the Royal Society of Canada, Vol. V, 1912. The type is the specimen figured by Billings as *Asaphus platycephalus* in the "Catalogue of the Silurian Fossils of Anticosti," page 26, fig. 9b. It differs from *B. alacer* (see Plate III, figure 6) principally in the character noted by Billings, that is, in the greater prominence of the eyes. The axial lobe of the thorax is also wider. Indeed, the axial lobe in *B. alacer* is very narrow for a *Brachyaspis*. In this connexion it should be noted that Salter's restored figure of *Brachyaspis* in "British Silurian Trilobites," p. 167, is very inaccurate in this particular, and does not agree with his own description of the type-species (*B. rectifrons*, Portlock). He says that the body-rings show a "very broad axis, much wider than the pleura," but in the figure the axial lobe is represented as being about one-third the total width of the thorax.

DESCRIPTION.

Entire animal oval, with semi-circular head and abdomen shields. Axial lobe of thorax wide (one-half the total width). Cephalon short, genal angles rounded, spineless, eyes large, high, less than their own length from the posterior margin of the cephalon. Profile of the cephalon one-fourth of a circle, no depressed border being present. In front of the eyes, the facial sutures reach the margin just before they unite in front, but are not so strictly marginal as in *B. alacer* and *B. notans*.

Pygidium semicircular, regularly convex, without depressed border. The axial lobe is faintly indicated, otherwise the surface is smooth.

The measurements of the type are: total length about 30 mm.; width, 19 mm.; width axial lobe of thorax, 10 mm.; length cephalon, 10 mm.; width, 19 mm.; distance between eyes, 8·5 mm. A more complete but smaller specimen is 20 mm. long and 14 mm. wide.

Locality.—The specimens are from the Richmond at English head, Anticosti. The type is number 2161 in the collection at the Geological Survey, Canada.

Canada
Geological Survey
Victoria Memorial Museum
BULLETIN No. 1

VII.—*Two New Species of Tetradium.*

By PERCY E. RAYMOND.

The following species of *Tetradium* seem to be distinguished from all described species by their habit of growth. Subdivisions based upon nice distinctions in the characters of the cells cannot be attempted until the whole genus is thoroughly restudied.

TETRADIUM HALYSITOIDES, SP. NOV.

Plate VI, fig. 3; Plate VII, fig. 1.

Corallum roughly hemispheric, composed of square corallites, which are joined into intersecting and anastomosing laminæ of single (sometimes double) layers of tubes united along the whole of their adjoining sides, as in *Halysites.* The tubes are nearly square in section, and show four primary septa, which extend over halfway to the centre. The lacunæ between the rows of tubes are rather large, and laminæ are usually made up of single rows of cells, although in some cases they are in double rows, as is shown in the upper part of the photograph. The weathered natural vertical section shown in the figure, shows rod-like supports extending across the lacunæ from one lamina to another.

The best corallum collected is 70 mm. in diameter, but larger specimens were seen in place. The corallites average about 1 mm. in diameter.

Locality.—The species seems to be fairly common in the lower part of the Lowville, near lot 25, con. VI, of Carden, Ontario, where the types were collected by W. A. Johnston. The holotype is No. 7839, and the paratype 7839a.

TETRADIUM RACEMOSUM, SP. NOV.

Plate VI, fig. 2,

Corallum consisting of elongate, irregular, bifurcating bundles of tubes which are square in section. The bundles vary from oval to rectangular in section, and often have a very irregular shape. Typically, the section shows the cells arranged four deep, and about 30 corallites to the bundle. The corallites in places vary widely from the typical square section. They seem to be rather thin walled, and the septa are thin and usually short. Tabulæ are scarce, or perhaps entirely absent. The corallites measure from 1 to 1·25 mm. in diameter, and, in section, one of the bundles is 11 mm. in greater diameter and 4·5 mm. in lesser.

Tetradium cellulosum[1] has never been properly described, but it would appear that the bundles contained fewer corallites than do those of the present species. The type-locality of Hall's species was Watertown, New York, and the writer has before him specimens from the Lowville at that locality. There seem to be two forms present, in both of which the bundles are smaller than those of *Tetradium racemosum*. In the larger form there are about 15 corallites to the bundle, and the corallites are very much smaller than those of *T. racemosum*. In the other form there are only 4 corallites in a bundle, and the bundles are only 1·75 to 2·25 mm. in diameter. This same form occurs in Canada in the township of McNab, and a photograph of a specimen from that locality is introduced for comparison (Plate VI, fig. 4). This can hardly be the typical *cellulosum*, however.

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[1] Hall, Palæontology New York, Vol. I, p. 39, 1847.

Canada
Geological Survey
Victoria Memorial Museum
BULLETIN No. 1

VIII. A Revision of the Species which have been Referred to the Genus Bathyurus.

PRELIMINARY PAPER.

By PERCY E. RAYMOND.

Billings erected the genus *Bathyurus* for trilobites of the type of *Asaphus extans*, Hall, but, in practice, did not adhere to his own definition, and described trilobites of all sorts as species of *Bathyurus*. In this, other writers have not been slow to follow his example, so that, at one time or another, some 50 species have been referred to this genus. The writer now knows of only 12 species, and 3 of these are described for the first time in this paper, which agree generically with the type of this genus. The attempt to dispose of the other species has necessarily led to the erection of several new genera, only one of which can be retained in the *Bathyuridæ*. The work so far done has covered only the species described by Billings, and as the assembling and study of the other species will cause a considerable delay, it is thought advisable to present the more important facts here. The final paper will include full descriptions and illustrations of all the species.

FAMILY BATHYURIDÆ, Walcott.

GENUS BATHYURUS, Billings.

Revised Generic Description.—Outline elongate oval, cephalon always longer than pygidium. Glabella subconical, expanding slightly towards the front, and extending almost to the anterior margin. Glabellar furrows nearly or quite obsolete. The facial suture begins at a point on the posterior margin back of the outer edge of the eye, runs diagonally inward while crossing the neck ring and furrow, encircles the eye, coming close to the glabella at the anterior corner of the palpebral lobe. From this point it turns outward again, but not far from the glabella, and reaches the anterior margin in front of the dorsal furrow, whence it extends around the frontal margin.

Eyes very large, from one-fourth to one-third the length of the glabella, and situated very close to the glabella and neck furrow. Free cheeks wide, with concave border, and spines of variable length at the genal angles.

Thorax with nine segments; pleura grooved, ends blunt.

Axial lobe of pygidium convex and prominent, with from one to three rings in the anterior end. Pleural lobes of pygidium with four pairs of ribs which usually extend across the concave border to the margin.

Type: *Bathyurus extans*, Hall.

BATHYURUS EXTANS, Hall.

Asaphus extans, Hall, 1847. Palæontology New York, Vol. I, p. 228, pl. 60, figs. 2a–2c.[1]

This species, which is, so far as is known, confined to the Lowville, has a very convex pygidium whose outline tends to be triangular rather than rounded. The glabella is rather smooth, but has a few fine pustules on the top. The pygidium is about three-fourths as long as wide.

BATHYURUS PERPLEXUS, Billings.

Bathyurus perplexus, Billings, 1865. Palæozoic Fossils of Canada, Vol. I, p. 364, fig. 350.

This species, as has already been pointed out by Walcott[2], is probably a synonym of *B. extans*. The specimen is a pygidium from Bonne bay, Newfoundland.

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[1] In the present paper, only the reference to the original publication of each species will be given. The full bibliography and synonomy will be given in the final paper.

[2] Bull. 30, U.S. Geol. Survey, 1896, p. 20.

BATHYURUS JOHNSTONI, SP. NOV.

Plate VII, figs. 2 and 3.

This species is very closely allied to *B. extans*, but is readily distinguished by characters which appear to be constant. The glabella is closely set with strong tubercles, while in *B. extans* there are only a few very fine scattered tubercles on that portion of the head. In *B. johnstoni*, too, the pygidium is less convex than in *B. extans*, and shorter. This species seems to have characters between *B. extans* and *B. longispinus*. The glabella and pygidium resemble the latter species, but the genal spines are as in *B. extans*.

Locality.—This species is common in the *Beatricea* beds of the Lowville at a number of places in central Ontario, notably at the locality near the southern fence of lot 26, range VI, of Carden, Ont. It also occurs at a similar horizon near Ottawa, below the base of the typical Lowville, and above the beds with *Bathyurus superbus*. The locality in which specimens have been collected at this horizon is along the Canadian Pacific Railway tracks one-half mile west of Mechanicsville, Ont. Named for W. A. Johnston, of the Geological Survey, who collected the types.

BATHYURUS SP.

Plate VII, fig. 6.

This species is intermediate between *Bathyurus extans* and *B. superbus*. It has a rounded pygidium with a fairly prominent axial lobe, and the pygidium has a wide depressed border; wider than in *B. extans*, but not so wide as in *B. superbus*. The glabella appears to be smooth, and if it has any pustules they must be very fine ones, as they do not affect the internal cast.

I have not named this species, as it was first collected and recognized as new by Dr. E. O. Ulrich, who will probably describe it.

Locality.—This species is fairly common in both the lower and upper part of the Pamelia formation in the vicinity of Clayton, New York. The figured specimen is from a locality near the river 3 miles west of Clayton, and was collected by Mr. E. J. Whittaker.

BATHYURUS SUPERBUS, RAYMOND.

Bathyurus superbus, Raymond, 1910. The Ottawa Naturalist, Vol. XXIV, p. 129, pl. II, figs. 1–3.

This species is characterized by its smooth test, short genal spines, the wide concave border of the pygidium, which border is, however, crossed by the ribs, and by the short and wide cephalon and pygidium. It attains a larger size than any other known *Bathyurus*. It has so far been found only near Ottawa, Ont., at a horizon about 35 feet below the top of the Pamelia formation.

BATHYURUS LONGISPINUS, WALCOTT.

Bathyurus longispinus, Walcott, 1879. 28th Report New York State Museum, p. 94.

This species is characterized by its very long and wide genal spines, pustulose surface, and short and wide pygidium. It occurs in the Leray-Black River, at Newport, New York.

BATHYURUS AMPLIMARGINATUS, BILLINGS.

Bathyurus amplimarginatus, Billings, 1859. Canadian Naturalist and Geologist, Vol. IV, p. 365, figs. 12a, 12b.

Bathyurus minganensis, Billings, 1865. Palæozoic Fossils of Canada, Vol. I, p. 353.

A comparison of the types show that these species should be united. The most prominent characteristic of the species is the very broad concave border of the pygidium. This border is not crossed by the ribs. The species has been reported only from the Beekmantown on the Mingan islands, but was found recently by Mr. Elfric Drew Ingall and the writer at Rockland, Ontario, in the lower part of the Beekmantown as exposed there.

BATHYURUS GLANDICEPHALUS, WHITFIELD.

Bathyurus (*Bathyurellus*) *glandicephalus*, Whitfield, 1890. Bulletin American Museum Natural History, Vol. III, p. 38, Pl. II, figs. 9–13.

This species occurs in the highest part of the Beekmantown in the Champlain valley (Bed E of Brainerd and Seely), and is a true *Bathyurus*. It is characterized by its very narrow glabella, and both the glabella and the axial lobe of the pygidium are rather low and smooth. The surface seems to be entirely without granules or pustules, and is marked by very fine but close-set wrinkles. On the pygidium the border is wide, and the ribs do not cross it. The species is more closely allied to *B. amplimarginatus* than to any other species of the genus, these two being the only ones in which the ribs do not cross the border and reach nearly or quite to the margin.

Whitfield evidently intended to place this species in *Bathyurellus*, but failed to understand the salient character of that genus, namely, the very concave and extremely broad border of the pygidia of the typical species. The low and smooth character of the glabella does indicate a proximity to that genus, however. The writer is indebted to Prof. Geo. H. Perkins, State Geologist of Vermont, for a recent opportunity of examining a good specimen of this species, collected at Providence island, Vt.

BATHYURUS ANGELINI, BILLINGS.

Plate VII, fig. 5.

Bathyurus angelini, Billings, 1859. Canadian Naturalist and Geologist, Vol. IV, p. 467, figs. 37.—Raymond, 1905. Annals Carnegie Museum, Vol. III, p. 335, Pl. 10, figs. 11, 12 (which see for further bibliography).

The strata which furnished the types of *Bathyurus angelini* prove, upon re-examination, to underlie the sandstone at the base of the Chazy, and a larger collection of fossils reveals a number of Beekmantown forms in the associated fauna, so that this species with its accompanying ostracods described from the same locality by Jones, have to be removed to the Beekmantown.

Bathyurus angelini proves to be exceedingly abundant at and near Grenville, and its most noticeable specific character is one pointed out by the writer in his previous description of the species, namely, the extension of the axial lobe across the border at the posterior end of the pygidium. The writer was, however, in error in calling the outline of the pygidium semi-circular, as it is really sub-triangular; much the same outline as in *Bathyurus extans*, but a little more pointed behind. The surface markings are also characteristic, the test, when preserved, being strongly granulose. The eyes are very large, and the border in front of the glabella very narrow and concave.

The hypostoma is like that of *B. extans*, except that the body portion is very much more convex.

BATHYURUS ACUTUS SP. NOV.

Plate VII, fig. 4.

This species is based upon a number of fragmentary specimens. A very perfect pygidium is selected as the holotype, and two cranidia, an hypostoma, a free cheek, and a larger pygidium are used as paratypes in making up the description.

Description.—Glabella regularly convex, rounded in front, extending nearly to the front of the cephalon, and limited in front by a narrow concave border. Surface smooth, without pustules, marked only by two pairs of faint furrows. Neck furrow narrow, and rather deep.

Fixed cheeks narrow, impressed by the neck furrow. Eyes large, close to the posterior margin. Free cheek with a relatively short genal spine.

Thorax unknown.

Pygidium triangular, the posterior end bearing a short acute spine. The axial lobe is narrow and prominent, with two rings beside the half ring in front. Otherwise smooth. On the pleural lobes there are four pairs of unfurrowed ribs, which extend across the concave border to the margin. Surface very finely granulose.

The hypostoma of this species is more like that of *B. angelini* than that of *B. extans*, as it has a rather convex body-portion.

This species is most closely allied to *Bathyurus angelini*, with which species I have identified poor specimens on previous occasions. With good pygidia, the spinose posterior end is sufficient to distinguish the species at once.

Measurements.—The pygidium used as the holotype is 7·5 mm. long and 8·5 mm. wide. A larger one is 9 mm. long and 12 mm. wide. The spine of this specimen is 2 mm. long.

Locality.—This species was collected by the writer in strata near the base of the Pamelia formation (ostracod layers) in a small cutting on the Canadian Pacific railway at Westboro, near Ottawa, Ont. The holotype is No. 7821 and the paratypes 7821 a–c.

BATHYURUS ARCUATUS, BILLINGS.

Bathyurus arcuatus, Billings, 1865. Palæozoic Fossils of Canada, Vol. I, p. 205, fig. 190.

A complete specimen of this species, which was evidently found after Billings' description was printed, adds to our knowledge, and shows that this is really a *Bathyurus*, allied to *B. acutus* and *B. angelini*. It is noteworthy for its very triangular shape, and the small, convex pygidium. The species has been found only in the famous boulder from St. Antoine de Tilly, which furnished so many novel species to Billings. It is probably of Beekmantown age.

BATHYURUS SPINIGER, (HALL).

Acidaspis spiniger, Hall, 1847. Palæontology New York, Vol. I, p. 241, Pl. 64, fig. 5.

This species is characterized by its pustulose surface and the long erect spine on the axial lobe of the pygidium. It is found in the Lowville and Black River, and possibly also in the lower part of the Trenton.

BATHYURUS INGALLI SP. NOV

Plate VII, fig. 7.

This last survivor of an interesting race of strictly American trilobites seems to be of rather frequent occurrence, though hardly to be called common, in the lower Trenton of Ontario. It appears to be a direct descendant of *Bathyurus spiniger*, but as it is very imperfectly known, better specimens may show that it is less closely related than it now seems to be. It is distinguished from all other species of the genus by the great size of the spine on the neck-ring. The cranidium is the only portion known. The glabella is covered with rather large tubercles, and the glabellar furrows are obsolete. On a specimen in which the cranidium is 22 mm. long, the spine on the neck ring is 16 mm. long. This spine is stout, circular in section, tapers regularly, and the surface is smooth except near the base, where there seem to be a few tubercles. The eyes are large, and close to the posterior margin.

Locality:—The type is from the lower part of the crinoid beds near the Lift-lock 2 miles north of Kirkfield, Ontario, where a number of specimens were collected by Mr. W. A. Johnston and the writer. There has long been a specimen of this species, collected at Belleville, Ont., on exhibition in the Museum under the name of *B. spiniger*. This is from about the same horizon as the last, that is, within 50 feet of the base of the Trenton. The writer has also collected it near Ottawa, in an old quarry on the first road beyond the cemetery in Eastview, in the lower part of the cherty crinoid beds, and about 60 feet above the base of the Trenton.

BATHYURUS SCHUCHERTI, CLARKE.

Bathyurus schucherti, Clarke, 1897. Palæontology of Minnesota, Vol. III, Pt. II, p. 724, figs. 41, 42.

This species is allied to *B. ingalli*, but has the glabella smooth and only a short spine on the neck ring. The type was from the "Lower Buff" limestone at Minneapolis, Minn.

GENUS PETIGURUS NOV.

(*Petigo*, scab; *oura*, tail.)

The trilobites of this genus are apparently closely allied to *Bathyurus*, but differ in the following points:—

The facial suture reaches the posterior margin near the genal angle; the anterior end of the glabella overhangs the concave border, glabellar furrows are entirely absent; and the eyes are somewhat farther forward. The pygidium is without concave border; the ribs of the pleural lobes are reduced to nodes; and the axial lobe is ringed for almost its entire length.

Type: *Bathyurus nero,* Billings.

PETIGURUS NERO, (Billings).

Plate VII, fig. 8.

Bathyurus nero, Billings, 1865. Palæozoic Fossils of Canada, Vol. I, p. 260, figs. 243 a-d.

This species is covered by the generic description. The species is common at a number of localities on the western side of Newfoundland.

Professor Reed has recently described a small, imperfect head-shield from the west of Ireland (Glensaul) as *Bathyurus* aff. *nero.* This specimen is of particular interest, as the genus *Bathyurus* has not previously been reported from Europe. The single specimen found agrees with *P. nero.* in having a tuberculated glabella and neck ring, large eyes, and oblong glabella. It differs from that species, however, in having a wider and more nearly rectangular glabella, in the profile of the glabella, and in the position of the eyes, which are near the centre of the head in the Irish specimen. The most important difference, however, is in the shape of the fixed cheek. The Irish specimen is incomplete, but, according to the figure, the posterior end of the facial suture turns sharply outward behind the eye, forming a broad fixed cheek. This is very different both from *Petigurus nero* and from any species of *Bathyurus.*

PETIGURUS CYBELE, (Billings).

Bathyurus cybele, Billings, 1859. Canadian Naturalist and Geologist, Vol. IV, p. 366, fig. 12c.

Very similar to *P. nero.* From the "White limestone" of the Beekmantown at the Mingan islands.

FAMILY SOLENOPLEURIDÆ, ANGELIN.

GENUS HYSTRICURUS NOV.

(*hystrix*, porcupine; *oura*, tail.)

Bathyurus conicus and *B. cordài* differ from typical *Bathyurus* in the glabella, which is short and tapers towards the front, instead of expanding in that direction. The elevated ridge on the fixed cheeks outside the dorsal furrow is another feature unknown in *Bathyurus*, but reminds one of *Ptychaspis* or *Cyphaspis*. The affinities of the genus seem to be with *Solenopleura* and *Ptychoparia*, the general shape of the glabella, the course of the sutures, the form of the cranidium in front of the glabella, and the pygidium, are similar in these genera. *Hystricurus* differs from *Ptychoparia* in having the glabella somewhat longer and unfurrowed, and in the absence of eye lines. Unfortunately, the thorax of the present genus is unknown.

GENERIC DIAGNOSIS.

Glabella conical, tapering towards the front, outlined by deep furrows at sides and front. Glabellar furrows absent. Fixed cheeks long, extending nearly to the genal angles. Dorsal furrows paralleled by a narrow convex ridge. Eyes of medium size, situated opposite the middle of the glabella. Cranidium with deeply concave border in front.

Pygidium rounded, with concave border. Axial lobe prominent, with 5 rings, and there are five pairs of ribs on the pleural lobes. Surface smooth or pustulose.

Type, *Bathyurus conicus*, Billings.

HYSTRICURUS CONICUS, (Billings).

Plate VII, fig. 9.

Bathyurus conicus, Billings, 1859. Canadian Naturalist and Geologist, Vol. IV, p. 366, fig. 12c.

The surface is strongly pustulose. It is found in the Beekmantown at St. Timothy and elsewhere on the Beauharnois canal in Quebec, at Fort Cassin, Vt., and at Fort Ticonderoga and Comstock Landing, New York.

Hystricurus crotalifrons, (Dwight).

Bathyurus ? *crotalifrons*, Dwight, 1884. American Journal of Science, 3d series, p. 253, Pl. 7, figs. 4, 4a, 5, 6.

Differs from *H. conicus* only in the longer and more tapering glabella. Found in the Beekmantown at Rockdale, New York.

Hystricurus cordai, (Billings).

Bathyurus cordai, Billings, 1860. Canadian Naturalist and Geologist, Vol. V, p. 321, fig. 26.

Bathyurus seelyi, Whitfield, 1889. Bulletin American Museum Natural History, Vol. 11, p. 62, Pl. 13, figs. 8-14. Not *B. seelyi*, Whitfield, Vol. I, 1886, which is *Bolbocephalus seelyi*.

This species has a smooth, and not a pustulose surface. It has been found in the conglomerates at Point Levis, and in the Beekmantown at Philipsburg, Quebec, Beekmantown, New York, and probably at Comstock Landing, New York. Also at Cow head, Newfoundland. (Specimens identified by Billings as *B. conicus*).

Family Proëtidæ Barrande.

Genus Haploconus nov.

(*haploos*, simple; *konos*, cone.)

This genus is proposed to include trilobites closely related to *Cyphaspis*, but differing in not having isolated basal lobes on the glabella, and in having a less prominent axial lobe on the pygidium.

Type, *Bathyurus smithi*, Billings.

Cyphaspis ? *galenensis*, Clarke, is a second species, and it is probable that *C ? brevimarginata*, Walcott, belongs here also.

The genus *Cyphaspis* was proposed by Burmeister for a trilobite with a very prominent glabella, which was surrounded by a deep furrow, and which did not extend as far forward as did the glabella of *Proëtus*. The front of the glabella is separated from the marginal rim by a distinct roll, as is well shown in fig. 3 of Plate III of Burmeister's "Organization des Trilobites." The eyes, too, are separated from the glabella by this same roll, a rounded ridge which starts at the neck furrow and encircles the glabella, outside the deep furrow. These seem to be the principal characters in which *Cyphaspis* differs from *Proëtus*, and the proposed genus has these characters, yet agrees with *Proëtus* in lacking the isolated basal glabellar lobes which are so prominent a feature in the cephalon of *Cyphaspis.*

HAPLOCONUS SMITHI, (Billings).

Plate VII, figs. 13 and 14.

Bathyurus smithi, Billings, 1863. Geology of Canada, p. 153, fig. 115.—1865, Palæozoic Fossils of Canada, Vol. I, p. 56.

This species was founded upon a very small fragment, showing only the glabella and portions of the fixed cheeks. There is now at hand, however, a very beautiful complete specimen, collected by Mr. Lawrence M. Lambe, Vertebrate Palæontologist to the Geological Survey, at the typical locality, Peterboro, Ontario. The entire specimen is 3 mm. long, and is probably not an adult, as it has only 7 segments in the thorax. Except for the small number of segments, it does not, however, show characters of immaturity.

DESCRIPTION.—Entire body broadly oval, the cephalon with long genal spines which extend back as far as the pygidium.

Cephalon short, tumid, the glabella forming the highest part. Glabella oval, smooth, with faint indications of one pair of furrows. Glabella surrounded by a deep groove, which is paralleled by a rounded ridge which, at the front, intervenes between the glabella and the upturned marginal rim. The eyes are small, well forward, and separated from the glabella by the ridge just mentioned. The facial suture cuts the posterior margin well within the genal angle, and reaches the anterior margin in front of the eye. The genal angles bear long, rounded spines.

Thorax with seven segments (in an immature specimen), which are bent very abruptly at the sides. Axial lobe narrow.

Pygidium small, showing three rings on the axial lobe, and three pairs of ribs on the pleural lobes. The axial lobe is not prominent, as in *Proëtus* and *Cyphaspis*, but low, triangular, and separated from the pleural lobes by narrow furrows, which meet behind the axial lobe, thus isolating it.

LOCALITY.—From the Trenton, probably a little above the *Prasopora* bed, at Peterborough, Ont. Collected by Lawrence M. Lambe, in 1891.

FAMILY DIKELOCEPHALIDÆ, MILLER.

GENUS PLATYCOLPUS NOV.

(*platys*, broad; *colpos*, furrow.)

This genus is proposed for trilobites with hemispheric, rather smooth cephalon, a depressed glabella extending to the anterior border, which is a flat, striated rim; glabellar furrows faint or absent, eyes small, situated midway on the length of the head; facial sutures cutting the posterior margin just inside the genal angles, and the anterior margin in front of the eye.

Pygidium semicircular, without depressed border, and with faint traces of segmentation.

TYPE: *Bathyurus capax*, Billings.

PLATYCOLPUS CAPAX (Billings).

Plate VII, figs. 20 and 21.

Bathyurus capax, Billings, 1860. Canadian Naturalist and Geologist, Vol. V, p. 318, fig. 20.

This species is common in the conglomerates at Point Levis, and is supposed to be upper Cambrian in age.

PLATYCOLPUS EATONI, (Whitfield).

Dikelocephalus eatoni, Whitfield, 1878. Annual Report Geological Survey of Wisconsin for 1877, p. 65.

Distinguished from *P. capax* by the presence of faint glabellar furrows. The species is found in the magnesian limestone of the Devils Lake district, Baraboo, Wisconsin.

PLATYCOLPUS DUBIUS, (Billings).

Bathyurus dubius, Billings, 1860. Canadian Naturalist and Geologist, Vol. V, p. 319, fig. 21.

Differs from *P. capax* in having a more pointed glabella and a wire-like rim. It is found in pebbles at Point Levis, and a similar but larger specimen was found by Richardson at Cow head, Newfoundland.

PLATYCOLPUS BARABUENSIS, (Whitfield).

Dikelocephalus barabuensis, Whitfield, 1878. Annual Report Geological Survey of Wisconsin for 1877, p. 63.

Similar to *P. dubius*, but with a more convex glabella and faint traces of glabellar furrows. Same horizon and locality as *P. eatoni*.

FAMILY AGRAULIDÆ.

GENUS PLETHOPELTIS NOV.

(*pletho*, to be full; *pelta*, a half-moon shield.)

GENERIC DIAGNOSIS.

Cephalon strongly convex, wider than long, without concave border or marginal rim. Glabella faintly defined, without glabellar furrows. Eyes small, situated well forward. Free cheeks rather wide, smooth, with short spines at the genal angles. Pygidium small, with few traces of segmentation; convex, no border.

TYPE: *Agraulos saratogensis*, Walcott.

PLETHOPELTIS SARATOGENSIS, (Walcott).

Agraulos saratogensis, Walcott, 1890. Proceedings of the U. S. National Museum, Vol. XIII, p. 276, Pl. XXI, fig. 14.

This species is found in the upper Cambrian Hoyt limestone near Saratoga Springs, and in the upper part of the Kittatinny limestone (upper Cambrian), near Blairstown, New Jersey.

PLETHOPELTIS ARMATUS, (Billings).

Plate VII, fig. 18.

Bathyurus armatus, Billings, 1860. Canadian Naturalist and Geologist, Vol. V, p. 319, fig. 23.

Found in the pebbles at Point Lévis.

FAMILY UNCERTAIN.

GENUS GONIURUS NOV.

(*gonia*, angle; *oura*, tail)

GENERIC DIAGNOSIS.

Facial suture as in *Bathyurus*, except that the fixed cheek extends a little farther toward the genal angle. Eyes very long, narrow, and close to the glabella. Glabella long, reaching almost to the frontal margin, tapering rapidly in front of the eyes. Neck furrow sharp, extending across fixed and free cheeks. Genal angles with short, sharp spines. A narrow, elevated rim extends around the whole cephalon, and the cephalon is slightly nasute in front. Pygidium convex, triangular, with a long terminal spine.

TYPE: *Bathyurus perspicator*, Billings.

GONIURUS PERSPICATOR, (Billings).

Plate VII, fig. 10.

Bathyurus perspicator, Billings, 1865. Palæozoic Fossils of Canada, Vol. I, p. 205, fig. 191.

This species was very abundant in the "boulder at St. Antoine de Tilly."

GONIURUS CAUDATUS, (Billings).

Bathyurus caudatus, Billings, 1865. Palæozoic Fossils of Canada, Vol. I, p. 261, fig. 245.

This species is fairly common in the Beekmantown at Ft. Cassin, Vt., and Ft. Ticonderoga, N.Y. The original specimens were from horizons G and H., Port au Choix, Newfoundland.

GONIURUS ELONGATUS, SP. NOV.

Plate VII, figs. 11 and 12.

Known from pygidia only.

Pygidium large, triangular, with a long, narrow terminal spine. The main portion of the pygidium, disregarding the spine, is broadly triangular, only gently convex. The axial lobe is broad, encircled behind by the dorsal furrows, and shows two distinct rings which cross the lobe, and three others which are visible only at the sides. The pleural lobes are nearly smooth on specimens with the test, but exfoliated examples show two broad flat ribs on each pleural lobe. The surface is marked by fine, wavy, impressed lines.

LOCALITY AND FORMATION.—From the upper part of the Beekmantown on the road between Philipsburg and St. Armand, county of Missisquoi, Quebec.

GENUS LLOYDIA, VODGES.

Bulletin U. S. Geological Survey No. 63, 1890, p. 97.

GENERIC DIAGNOSIS.

Whole animal oblong in outline, cephalon and pygidium regularly rounded, with elevated convex borders. Cephalon convex, glabella usually tapering towards the front and reaching to the marginal border. Glabella outlined by shallow or deep dorsal furrows. Eyes small, near the dorsal furrows, and situated halfway to the front. Facial sutures cut the posterior margin at the genal angles and the anterior margin in front of the eyes. Genal angles usually without spines.

Thorax of nine segments; pleura deeply grooved, ending in long, acute spines.

Pygidium with narrow axial lobe, which may have from 1 to 8 rings. Pleural lobes smooth. The convex border which encircles the pygidium is set off by a shallow furrow.

TYPE: *Bathyurus bituberculatus*, Billings.

LLOYDIA BITUBERCULATUS, (Billings).

Plate VII, fig. 15.

Bathyurus bituberculatus, Billings, 1860. Canadian Naturalist and Geologist, Vol. V, p. 319, fig. 22.

Fairly common in the conglomerates at Point Lévis, in pebbles of Beekmantown age.

LLOYDIA SAFFORDI, (Billings).

Plate VII, fig. 16.

Bathyurus saffordi, Billings, 1860. Canadian Naturalist and Geologist, Vol. V, p. 321, fig. 24.

Differs from the preceding in lacking the basal lobes on the glabella, and in the more convex glabella and pygidium. The species is common in the Beekmantown at Philipsburg, and in pebbles at Point Lévis. Richardson found it at Cow head, Newfoundland.

LLOYDIA SOLITARIUS, (Billings).

Bathyurus solitarius, Billings, 1865. Palæozoic Fossils of Canada, Vol. I, p. 362.

Very similar to *L. saffordi*. The type is lost, and no other specimens are known. The locality was Hare bay, Newfoundland, and the specimen was found loose.

LLOYDIA OBLONGUS, (Billings).

Bathyurus oblongus, Billings, 1860. Canadian Naturalist and Geologist, Vol. V, p. 321, fig. 25.

Similar to *L. saffordi*, but the glabella has straight sides, instead of tapering forward. A rare species in the conglomerate at Point Lévis.

LLOYDIA ? STRENUUS, (Billings).

Bathyurus strenuus, Billings, 1865. Palæozoic Fossils of Canada, Vol. I, p. 204, fig. 188.

This species is referred to *Lloydia* with considerable doubt. It looks more like a *Bathyurus* than do typical species of *Lloydia*, but has small eyes, and an elevated. wire-like rim. The specimens are from the boulder at St. Antoine de Tilly.

GENUS LEIOSTEGIUM NOV.

(*leios*, smooth; *stege*, covering.)

GENERIC DIAGNOSIS.

General form elongate oval, cephalon and pygidium nearly equal, both rounded, smooth, and convex. Glabella quadrate, outlined by deep, narrow, dorsal furrows, and extending to the very narrow elevated anterior rim. Fixed cheeks wide, eyes small, and far from the glabella. Thorax of nine segments. Pygidium almost semicircular, unsegmented; axial lobe elevated, extending nearly the whole length. No concave border.

TYPE: *Bathyurus quadratus*, Billings.

LEIOSTEGIUM QUADRATUM, (Billings).

Plate VII, fig. 17.

Bathyurus quadratus, Billings, 1860. Canadian Naturalist and Geologist, Vol. V., p. 321, fig. 27.

This species is known only from the conglomerate at Point Lévis, and is probably of Beekmantown age.

LEIOSTEGIUM BREVICEPS, (Billings).

Bathyurus breviceps, Billings, 1865. Palæozoic Fossils of Canada, Vol. I, p. 262, fig. 246.

Differs from the preceding in having a shorter and less quadrate glabella. Found at horizon N, Table head, Newfoundland.

Two other species of this genus, *Triplecia spiriferoides*, McCoy,[2] and *Triplecia grayiæ*, Davidson,.[3] come from Great Britain, the former being found in the Caradoc of Wales and Ireland, and the latter in the same formation from Scotland and Wales. *Triplecia spiriferoides* has a shorter pedicle beak than *Oxoplecia calhouni* and a much wider hinge line, which features greatly alter the proportions of the cardinal area. *Triplecia spiriferoides* also "is covered with numerous, very fine, radiating, thread-like, raised striæ" in place of the larger and fewer plications of *Oxoplecia calhouni*. The average specimen of the Canadian species is somewhat wider and more gibbous. The *Triplecia grayiæ* is a smaller shell and not so wide in proportion to its length as either *Triplecia spiriferoides* or *Oxoplecia calhouni*. The greatest width is nearer the front than in the *Oxoplecia calhouni*, and the cardinal angles are more prominent, standing out like shoulders. The elevation of the fold in *Triplecia grayiæ* divides the shell into three almost equal lobes while the fold in *calhouni* is only about one-fourth of the whole width. The fold in *Triplecia grayiæ* is more rounded and the striæ, like those of *Triplecia ulrichi*, appear to continue down the sides instead of having the smooth, abrupt margins of the fold as in *Oxoplecia calhouni*. The delthyrium of *T. grayiæ* is covered by a deltidium, "elevated along the middle" in contrast to the flat deltidium of *O. calhouni*.

The Bohemian species, *Orithisina cava*, Barrande[3], is more like *Triplecia ulrichi* in general proportions. It has the less prominent and more rounded fold and sinus, with striations upon the sides as well as the top. The hinge line is wider than *Oxoplecia calhouni* and the beak of the pedicle valve is shorter.

Formation.—The base of the Utica.

Locality.—Ottawa, Canada: north of Carling avenue, between Rochester and Preston streets. The associated species are: *Conularia trentonensis*, Hall; *Diplograptus* sp. indt.; *Leptobolus insignis*, Hall; *Schizocrania filosa*, Hall; *Lingula progne*, Billings; *Dalmanella emacerata*, Hall; *Plectambonites sericeus* (Sowerby);

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[1] British Silurian Brachiopoda, Vol. III, p. 275, pl. 37, figs. 3-7, 1886-71. Brit. Sil. Brach. Supplement Vol. V, p. 146, pl. 8, fig. 30, 1882-84.

[2] British Silurian Brachiopoda, Vol. III, p. 198, pl. 24, figs. 31, 32; pl. 25, figs. 9-11, 1886-71. Brit. Sil. Brach. Supplement, Vol. V, p. 144, pl. 8, fig. 32, 1882-84.

[3] Système Silurien du Centre de la Bohême, Vol. V, pl. 59, fig. iv, 1-7, 1879.

Rafinesquina alternata (Emmons); *Ctenodonta pulchella* (Hall); *Trocholites ammonius*, Hall; *Triarthus becki*, Green; *Ogygites canadensis* (Chapman); *Calymene senaria*, Conrad; and *Isotelus gigas*, Dekay.

The cotypes are in the Victoria Memorial Museum of Canada, numbers 7768, a-c, and were collected by the writer.

Postscript.—After the above was in type, it was discovered that the generic name Cliftonia had been proposed by Dr. Foerste[1] for striated Triplecias. Dr. Foerste's type is Cliftonia striata, a shell found in the Clinton at Clifton, Tenn. He describes it as having the external appearance of an Atrypa, with a very short hinge and a sub-circular form. The shape of the Silurian form is so different from that of any of the species referred to Oxoplecia in this paper, that the writer is not satisfied that they all belong to the same genus, though if such proves to be the case Cliftonia will take precedence over Oxoplecia.

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[1] Bulletin Denison University, Vol. XIV, p. 82, pl. 3, figs. 39, 42; pl. 4, fig. 70, April, 1909.

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X.—*A New Genus of Dicotyledonous Plant from the Tertiary of Kettle River, British Columbia.*

By W. J. Wilson.

During the summer of 1911, Mr. Leopold Reinecke of the Geological Survey, brought in a small number of fossil plants from a lens-shaped mass of white tuff in a conglomerate on Curry creek on the West fork of Kettle river in the Beaverdell district, southern British Columbia. In this collection there are two dicotyledonous leaves which I have not been able to place satisfactorily in any described genus to which I have access.

In the hope that more specimens will be obtained from this locality which will throw further light on the place these leaves occupy in the botanical scale, I will describe them provisionally under the generic name Lebephyllum, from λεβης kettle, and φυλλον a leaf, Kettle river being the type locality.

Lebephyllum gen. nov.

Leaves rhombic-oval to rhombic-lanceolate; basal margin entire; apical margin crenate-dentate, cuneate at the base, three veined. Detailed characters under specific description. Type: *L. reineckei.*

In general appearance these leaves resemble those of an herbaceous plant, as suggested by Professor John Macoun, and in the general form, venation, and the peculiar dentate margins they approach nearest the living genera Pilea and Urtica in the Nettle family. They agree particularly in the rounded teeth and the long point at the apex. In Pilea and Urtica the leaf is dentate closer to the base, and the basal part is not so distinctly wedge-shaped, the margins being convex instead of straight or slightly concave as in Lebephyllum. They agree in having a distinct midrib running from the base to the apex, but the lateral veins differ materially. Fragaria is another genus to which the broad form of the Kettle River leaf bears a strong resemblance, but in Fragaria the teeth are pointed instead of round, the apex is more obtuse and lacks the long tooth, and the venation is feather-veined.

LEBEPHYLLUM REINECKEI, sp. nov.

Plate IX, figs. 1 and 2.

Leaves rhombic-oval to rhombic-lanceolate, wedge-shaped at the base, the basal margin entire, the apical margin deeply crenate-dentate, the toothed part occupying a little more than half the margin; 5 to 7 centimetres long and 2 to 3 centimetres broad. A strong midrib runs from the base to the apex. Near the base opposite, lateral veins, not quite as strong as the midrib, branch off at an angle of about 13 degrees and run almost straight to the margin. In the smaller specimen, fig. 2, two similar pairs are given off at regular intervals towards the point, and in the larger leaf, fig. 1, only one pair is seen above the one at the base. In this the veins do not seem to be quite opposite, though only the right vein is distinct. Each vein seems to terminate in a tooth, but owing to the state of preservation this is not well shown. The ultimate reticulation is not seen.

Specimens in the Museum of the Geological Survey, Canada, Ottawa. Catalogue numbers 8038 holotype, fig. 1, and 8038a paratype, fig. 2.

Locality: West fork of the Kettle river, Beaverdell district, southern British Columbia.

Formation: Tertiary, probably Miocene.

Collector: Leopold Reinecke, 1911.

The writer wishes to acknowledge his indebtedness to Dr. F. H. Knowlton, of the United States Geological Survey, Washington, D.C., and to Professor John Macoun and Mr. L. M. Lambe, of this Department, for kindly criticism and helpful suggestions in the preparation of this paper.

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XI.—*A New Species of Lepidostrobus.*

By W. J. Wilson.

During the summers of 1909 and 1910 the writer spent a short time at the Minto coal mines near Grand lake, New Brunswick, collecting fossil plants. These fossils are found in great abundance in a somewhat dark grey shale lying above the coal. A portion of the shale is removed in mining the coal and thrown on the dump. The shale is fine and free from grit and has preserved perfectly the minutest impressions of the plants. Unfortunately for the collector, the shale, which is hard and firm when first thrown out, begins to crumble as soon as exposed to the changes of the atmosphere and in a short time is reduced to a fine powder. If, however, it is collected as soon as it comes from the mine and kept dry, it remains solid indefinitely. Although plant remains are abundant and for a long time have been known to occur in the vicinity of Grand lake, no systematic collecting has been done in the past. Sir J. W. Dawson has identified or described about thirty species from different places in the Grand Lake basin, chiefly from Coal creek, for the most part collected by Professor C. F. Hartt.

Among the many beautiful specimens collected by the writer at the Minto mines there were several fragments of cones belonging to the genus *Lepidostrobus*, two being sections with the scales attached. Besides these there were over fifty detached scales, some of them perfect, showing both sporangiophore and blade. These scales when separate from the cone are usually described under the genus *Lepidophyllum.* The cones are supposed to be the fruit of Lepidodendron and are allied to the recent *Lycopodiaceæ.*

I have carefully compared the cones and scales collected at Minto with all the descriptions and figures of Lepidostrobus and Lepidophyllum available, but have not been able to identify them specifically. I will, therefore, describe them under the name—

LEPIDOSTROBUS MINTŌENSIS sp. nov.

The specimens on which the species is founded are the section of the largest cone, the type (Plate IX, fig. 3), and two detached scales, figs. 4 and 5. These specimens are in the Museum of the Geological Survey, Canada, catalogue numbers 7544, 7545, 7545a. No. 7544 was collected by Mr. W. B. Evans at the Rothwell Coal Company's mine; No. 7545 was collected by the writer at the King Lumber Company's mine, and No. 7545a at the Thurrett mine.

The section of the cone shows about 14 attached scales in a whorl. Diameter from tip to tip of blades of scales, 5·5 cm.; from base to base of blades 2·6 cm., diameter of axis 6 mm. Sporangiophore 9 mm. long and about 7 mm. broad where it joins the blade, triangular with a distinct keel on the dorsal surface, with two low ridges, one on each side of the keel, converging towards the axis. The ventral surface has corresponding grooves or depressions. The keel is higher at the distal end and gradually tapers to the axis, while the lateral ridges begin with an oblong projection at the distal end and gradually disappear towards the axis. The blades are 15 mm. long and about 9 mm. broad at the base. They are broadly triangular and are rather sharply pointed, the apical angle being about 40°, while the angles at the base are slightly rounded. The base or side attached to the sporangiophore is distinctly concave and the sides are slightly so. Some of the blades have a more or less distinct median vein, and some have crinkled edges.

Separate scales which are identical with those attached to the cone figured on Plate IX, are common at nearly all the Minto mines, and sometimes they are found in groups of two or more.

Some of the characters, which are not well shown on those attached to the cone, have been taken from the detached specimens. In one of the largest and best preserved of the separate scales (Plate IX, fig. 4) the sporangiophore is 12 mm. long and 9 mm. broad; the blade is 17 mm. long and 12 mm. broad, with the apical angle 44°. In over 50 separate specimens examined the apical angle ranges from 40° to 50°.

The species most closely allied to *Lepidostrobus mintōensis* are *Lepidophyllum triangulare* Zeiller, *L. pichleri* Kerner, *L. jenneyi* White, *L. ovatifolium* Lesq., *L. brevifolium* Lesq., and perhaps *Lepidostrobus ? trigonolepis* Bunbury. Both *Lepidophyllum triangulare* and *L. pichleri* have not only acute apices of the blades but the angles at the base are sharply pointed, while the basal angles of the Minto specimens are slightly rounded and the blade is generally of a much broader type. The sporangiophores of the latter are slightly longer, indicating a larger cone, and they are generally broader. Zeiller's species, on the contrary, are described as characteristically narrow. The scales of *Lepidophyllum jenneyi* seem to have shorter sporangiophores and the blades are slightly convex at the border and less pointed at the apex than the Minto specimens, and they have semiangular or rounded dilations or auricles at the base. Compared with the Minto scales *Lepidophyllum hastatum* is longer and much narrower, the blades of *Lepidophyllum ovatifolium* have convex borders and a more obtuse apical angle, while *Lepidophyllum brevifolium* have narrow sporangiophores and short blades with distinctly convex borders.

C. J. F. Bunbury in 1847 described a cone from the Sydney coal-field of Cape Breton, N.S., under the name *Lepidostrobus? trigonolepis*, the scales of which, he says, are of a "broad triangular form, acute," which agrees in a general way with the Minto scales, but he adds they are slightly convex and that they seem to be attached to the axis by a very short claw. These latter characters clearly separate it from the species here described. Unfortunately Bunbury did not figure his specimen and his description is too general to admit of exact comparison.

Lepidostrobus squamosus, Dawson, from Grand lake, N.B., was described as allied to Bunbury's species, but larger. The type is in the Redpath Museum, Montreal, and through the kindness of Professor F. D. Adams I had an opportunity of examining it. The blades are much narrower and more acute and probably longer than those of *L. mintöensis*, though the cones are nearly the same size. The sporangiophores are not shown clearly, but the two cones seem to be distinct.

The essential characters of *Lepidostrobus mintöensis* are:—Scales large, sporangiophore triangular, about three-fourths the size of the blade; keeled, with a low ridge on each side; blade broadly triangular, sharply pointed, basal angles rounded, lateral borders slightly concave. Locality: Minto, Sunbury county, New Brunswick. Middle coal formation. (Upper Pottsville).

I am indebted to Mr. W. B. Evans, manager of the Rothwell Coal Company, who kindly sent me specimen No. 7544, fig. 3; and to Dr. David White for figures of two of the species referred to in the text, and for valuable advice and suggestions as to the relation of the species.

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XII.—*Prehnite from Adams Sound, Admiralty Inlet, Baffin Island, Franklin.*

By Robt. A. A. Johnston.

The material which furnished the subject of this article was collected by Mr. Arthur English while engaged as prospector on the expedition of 1910-1911 of the Canadian Government steamer Arctic under the direction of Captain J. E. Bernier. The locality is given as near the head of Adams sound, which would make its position as about 73° 12′ north latitude and 82 30′ west longitude. And from information gained from a letter written by Mr. English to Dr. A. P. Low, Deputy Minister of Mines, in which he gives a summary of his observations upon the geological features of the country, it would appear that near the head of the sound extensive beds of shale are exposed. These shales are impregnated to a greater or less extent with iron pyrites and copper pyrites; the pyritous minerals occur in the form of flattened nodular concretions and thin scales and are particularly abundant along the contact with gabbroid intrusives by which the shales are extensively invaded; these intrusives often take the form of dykes of large proportions, ranging from 1 foot to 30 feet or 40 feet in width. In the neighbourhood of these intrusives the strata are traversed by numbers of vertical veins of quartz and calcite, in which galena and pyrite and even fine particles of native gold have sometimes been observed. And it is presumably from one of these quartz-calcite veins that the mineral under consideration has been obtained.

The specimens as received by the writer are two in number and are excellent examples of vein formation. They present a nearly uniform thickness of 2 inches, and in one of the specimens there is evidence of some contortion. The principal constituents are the quartz and calcite as mentioned by Mr. English, and the prehnite, which forms the chief motive of this article; in addition to these, a very few minute particles of a dark or nearly black mineral have been observed scattered sparsely through the vein; thin sections of the veinstone were examined by Professor Pirsson and Mr. Drysdale, of New Haven, Conn., and this dark mineral was shown by them to be axinite; no other minerals than those mentioned have been observed in these specimens. The most abundant mineral in the vein is a translucent quartz, all but white in colour, there being an almost insensible purplish tinge present. The quartz for the most part takes the form of groups of imperfectly defined crystals radiating from loci midway between the wall and the centre of the vein; the individuals of these groups find, as might be expected, their greatest development towards the inner portions of the vein, and in many cases they terminate at the opposite wall; while, contrariwise, their development has been arrested in early stages of their growth. These groups are thus generally very irregular in their outlines; some show a semi-spherical outline, while others are more or less elongated in one direction and flattened or compressed in a direction normal to it. The calcite and the prehnite, which are approximately equal in amount, fill the interspaces between groups of quartz individuals. The calcite is white in colour and does not present any unusual characters.

THE PREHNITE.

As indicated above, the prehnite seems to be more intimately associated with the calcite than with the quartz. In the hand specimens the prehnite may be observed in small patches and reticulations up to one-fourth of an inch in width; these to the unaided eye, or with a hand lens, appear to be homogeneous; in thin sections, however, they are seen to be contaminated with more or less calcite and some quartz; it has a rather indistinct prismatic cleavage. Prof. Pirsson, who has examined the mineral optically, has furnished the following notes regarding it: birefringence $>0{\cdot}20$; index of refraction $>0{\cdot}16$; parallel extinction; optic axial angle positive. The colour is a very pale green; it is perfectly translucent and has a weak, pearly lustre.

In thin sections under the microscope the prehnite is seen in the form of sheaves and bundles of minute crystals mixed with more or less of the calcite and some quartz. Its hardness is about 6. Before the blowpipe it fuses with swelling and contortion at about 3·5 to a brownish slag which is not easily further fused. On strong ignition in a closed tube it yields water. Previous to fusion the finely divided powder is not readily acted upon by strong hydrochloric acid; after fusion it gelatinizes perfectly.

For the purposes of an analysis a number of pieces of the mineral were first freed as far as possible by hand from associated quartz and calcite and then crushed to pass through a sieve of twenty meshes to the linear inch; the crushed material was then treated with dilute hydrochloric acid (1 HC: 6 H_2O) to remove calcite; it was then washed and allowed to dry at the ordinary temperature of the air for twenty-four hours, after which it was introduced into a Penfield's separatory tube charged with Thoulet solution of 2·8 S.G. The heavy separate was after a time removed, washed with KI solution and afterwards with pure distilled water; it was then spread out on glass plates and allowed to dry. As will be seen subsequently, however, this treatment probably did not effect a complete separation of the quartz, as the analysis shows an excess of 4·38% of silica over that required for normal prehnite. Its specific gravity at 15·5° C. was found to be 2·924, and an analysis of the material prepared as indicated above gave the following figures:—

Silica (SiO_2)	44·35
Alumina (Al_2O_3)	19·44
Ferric oxide (Fe_2O_3)	6·58
Calcium monoxide (CaO)	25·50
Water (H_2O)	4·00
	99·87

Chlorine and fluorin were sought quantitatively by the method of Berzelius, but with negative results in each case.

These figures afford the following molecular ratios:—

SiO_2	Al_2O_3	Fe_2O_3	CaO	H_2O
0·739	0·188	0·041	0·454	0·222
0·739	0·229		0·454	0·222
3	1		2	1

(+ 0·073).

The excess of 0·073 in the molecular ratio probably represents admixed quartz which would thus amount to 4·38 per cent. By subtracting this from the total silica and recalculating the remaining constituents the centesimal composition of the mineral is obtained. This is given in column I; the figures in column II are those obtained by Genth (American Philosophical Society, XX, 401, 1882) for another prehnite high in iron from Cornwall, Pennsylvania; these are added for purposes of comparison.

	I.	II.
Silica (SiO_2)	41·86	42·40
Alumina (Al_2O_3)	20·36	20·88
Ferric oxide (Fe_2O_3)	6·89	5·54
Calcium monoxide (CaO)	26·70	27·02
Water (H_2O)	4·19	4·01
	100·00	99·85

Owing to its high iron content it has been suggested by Professor Pirsson that this variety of the mineral be called *ferroprehnite.*

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XIII.—*The Marine Algæ of Vancouver Island.*

By Frank S. Collins.

The following pages are intended to include a list of all the marine algæ that have been collected on the shores of Vancouver island, with the exception of the Myxophyceæ and Diatomacæ. These orders are composed of inconspicuous plants, and have been little noticed in this region, and the Myxophyceæ, at least, are practically the same in all countries, so that their omission here will not be a serious defect.

The green algæ, while not so cosmopolitan as the blue-green, are seldom limited to this region; they are largely circumpolar, the same species being found in the North Atlantic as in the North Pacific; while to some extent this is the case with the brown algæ, most of the larger forms do not occur in the Atlantic, though many do occur on the Asiatic side of the Pacific. The red algæ include a large number of local forms, but here, also, there are species of circumpolar distribution.

Our first records[1] of algæ from this region were from Dr. Archibald Menzies, who was here about 1780, and again in the years 1792, 1793, and 1794 with the Exploring Expedition commanded by George Vancouver.

The most important paper is that of Prof. W. H. Harvey, 1862, giving a list of algæ collected near Esquimalt by Dr. David Lyall. A few species are noted by De Alton Saunders in his account of the algæ of the Harriman Expedition, 1901.

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[1] References to works cited will be by author's name and date; the full title of each is given in the list at the end of this paper.

The corallines of the vicinity of Port Renfrew were fully described by Dr. K. Yendo, 1901. All these records were summed up in the paper by Setchell & Gardner on the algæ of Northwestern America, 1903, together with some additions, mostly from the collections at Port Renfrew by Miss Eloise Butler and Miss Jessie E. Polley. To these can now be added the collections by Prof. John Macoun in the years 1887, 1893, 1908, and 1909, which considerably increase the number of species, and give additional localities for many species before reported.

Quite a number of Vancouver algæ have been distributed in the Phycotheca Boreali-Americana, by Collins, Holden, & Setchell, and in the Centuries of American Algæ by Miss Josephine Tilden; these will be referred to under their respective species.

The list is undoubtedly far from complete; a number of species even of the larger and more conspicuous algæ have been collected on the shores of Whidby island, which is United States territory, but only a few miles distant from the Vancouver Island shore, and there is every reason to suppose that they are to be found on the latter. Some other species occurring both to the north and the south of the island are to be expected.

The list is, however, full enough for us to form some general estimate of the character of the marine flora. As would be expected from the northeast-moving currents of the Pacific, it contains many more warm water species than are found in the same latitude on the Atlantic shore of British America, where the conditions are strictly arctic. On the other hand, some quite arctic species are to be found, notably in the genera *Agarum* and *Alaria*, which in the Atlantic are sharply marked off from the region of *Gracilaria, Scinaia, Laurencia*, etc. A table has been made up showing the distribution in other regions of the various species of brown and red algæ, except Corallinaceæ, here found, as far as we have authentic records.

Recent collections of Vancouver algæ which have been utilized for this paper are to be found in three herbaria: that of the Geological Survey at Ottawa, that of the University of California at Berkeley, California, and that of the author at Malden, Massachusetts. For some species reported in Harvey's Lyall paper and not since observed, the herbarium of Trinity

College should be consulted. No attempt will be made at elaborate synonymy; the names will as a rule follow Setchell & Gardner, 1903, and references will be made to that work, to Harvey's Nereis, Collins' Green Algæ of North America, and to such monographs as may seem desirable. Reference will be given to the Phycotheca Boreali-Americana for all species there distributed, whether the material distributed came from Vancouver or some other region. The Geological Survey has a full set of the work.

To Professor W. A. Setchell, of the University of California, the writer is indebted for valuable information as to type specimens in European herbaria; all references to such specimens in the following pages are from Dr. Setchell.

CHLOROPHYCEÆ.

COLLINSIELLA TUBERCULATA Setchell & Gardner, 1903, p. 204, Pl. XVII, figs. 1-7; Collins, 1909, p. 141; P. B.-A., No. 909; *Ecballocystis willeana* Yendo, 1903, p. 199, Pl. VIII, figs. 1-15. Forming minute tubercular growths on stones in pools, Port Renfrew, Yendo.

CHLOROCHYTRIUM INCLUSUM Kjellman. Setchell & Gardner, 1903, p. 206; Collins, 1909, p. 147; P.B.-A., No. 514; Tilden, Centuries, No. 389. Abundant in the tissues of *Sarcophyllis*, *Constantinea* and other membranaceous red algæ; when very abundant it gives a greenish shade to the host, but otherwise is only to be detected by microscopic examination. Esquimalt, Port Renfrew, and probably all around the island.

ENTEROMORPHA CLATHRATA (Roth) Greville. Collins, 1909, p. 199; P.B.-A., No. LXXVIII.

Nos. 29, 151, on stones at Amphitrite point and Ucluelet arm, Macoun.

E. CRINITA (Roth) J. G. Agardh. Setchell & Gardner, 1903, p. 214; Collins, 1909, p. 199; P.B.-A., Nos. 460, 965, 1325. Departure bay, Macoun.

E. COMPRESSA (L.) Greville. Setchell & Gardner, 1903, p. 213; Collins, 1909, p. 201. Esquimalt, Harvey. This species in Harvey's time was taken in a much broader sense than now, and his plants may possibly be referred to one of the following species. *E. compressa* in the narrower sense occurs on the Washington and California coasts, and it is to be expected here.

E. MIMIMA Nägeli. Setchell & Gardner, 1903, p. 213; Collins, 1909, p. 201; P.B.-A., Nos. 468, 912. Port Renfrew, Butler & Polley; Departure bay, Ucluelet, Macoun.

E. MARGINATA J. G. Agardh. Collins, 1909, p. 202; P.B.-A., No. 466. Departure bay, Macoun.

E. PROLIFERA (Fl. Dan.) J. G. Agardh. Setchell & Gardner, 1903, p. 211; Collins, 1909, p. 202; P.B.-A., Nos. 470, 610, 913. Esquimalt, Departure bay, Ucluelet, Macoun; probably generally distributed.

E. MICROCOCCA Kützing. Setchell & Gardner, 1903, p. 211; Collins, 1909, p. 204; P. B.-A., No. 66. Esquimalt, Departure bay, Macoun.

Var. SUBSALSA Kjellman. Setchell & Gardner, 1903, p. 211; Collins, 1909, p. 204; P.B.-A., Nos. 467, 1068. Esquimalt, Departure bay, Macoun.

E. INTESTINALIS (L.) Link. Setchell & Gardner, 1903, p. 212; Collins, 1909, p. 204; P.B.-A., No. 464. Common everywhere; probably the most universally distributed species of marine algæ. Very variable; occurring here under the following forms:—

Forma CYLINDRACEA J. G. Agardh. Setchell & Gardner, 1903, p. 212; Collins, 1909, p. 205; P. B.-A., No. 465.

Forma CLAVATA J. G. Agardh. Collins, 1909, p. 205; P.B.-A., No. 966.

Forma MAXIMA J. G. Agardh. Setchell & Gardner, 1903, p. 212; Collins, 1909, p. 205; P.B.-A., No. 1182.

E. LINZA (L.) J. G. Agardh. Setchell & Gardner, 1903, p. 212; Collins, 1909, p. 206; P. B.-A., Nos. 16, 967; Tilden, Centuries, No. 384. Esquimalt, Harvey; Victoria, Tilden.

MONOSTROMA LATISSIMUM (Kütz.) Wittrock. Setchell & Gardner, 1903, p. 207; Collins, 1909, p. 211; P. B.-A., Nos. 14, 1122. Ucluelet, Colquit river, Macoun.

M. FUSCUM (Post. & Rupr.) Wittrock, forma BLYTTII (Wittr.) Collins. Setchell & Gardner, 1903, p. 209; Collins, 1909, p. 213; P. B.-A., No. 715. Port Renfrew, Butler & Polley.

Forma SPLENDENS (Wittr.) Collins. Setchell & Gardner, 1903, p. 209; Collins, 1909, p. 213; P. B.-A., No. 911. Victoria, Saunders.

M. LEPTODERMUM Kjellman. Setchell & Gardner, 1903, p 209; Collins, 1909, p. 213; P.B.-A., No. 1272. *M. zostericolum* Tilden, Centuries, No. 388. On *Zostera*, Port Renfrew, Butler & Polley.

ULVA LACTUCA var. LATISSIMA (L.) DC. Setchell & Gardner, 1903, p. 210; Collins, 1909, p. 215; P. B.-A., No. LXXVI. Esquimalt, Harvey; Departure bay, Macoun; probably generally distributed. The mature plant seems to be always more or less regularly perforate; there are many snails that feed on algæ, and make the fronds more or less ragged, but in the material from the northwest coast the perforations are more regular than are found elsewhere; observations on the living plant are needed.

Var. RIGIDA (Ag.) Le Jolis. Setchell & Gardner, 1903, p. 209, Collins, 1909, p. 215; P. B.-A., No. 407. Port Renfrew, Butler & Polley; Esquimalt, Harvey; Victoria, Macoun. Probably generally distributed, occurring in more exposed stations than var. *latissima*. The common *Ulva* of the California coast is generally known as *U. fasciata* Delile, and no sharp line can be drawn between the two species.

ENDODERMA VIRIDIS (Reinke) Lagerheim. Collins, 1909, p. 279; P. B.-A., No. 1626. In *Apoglossum decipens*, Macoun.

RHIZOCLONIUM KERNERI Stockmayer. Collins, 1909, p. 329; P. B.-A., No. 623. Victoria, Macoun.

R. RIPARIUM (Roth) Harvey. A common species appearing under two forms:—

Var. POLYRHIZUM (Lyngb.) Rosenvinge. Collins, 1909, p. 328; P. B.-A., No. 24. Esquimalt, Macoun.

Var. IMPLEXUM (Dillw.) Rosenvinge. Setchell & Gardner, 1903, p. 222; Collins, 1909, p. 328; P. B.-A., Nos. 266, 976; Tilden, Centuries, No. 379. Departure bay, Colquits, Macoun; Pedder inlet, Tilden.

CLADOPHORA GLAUCESCENS (Griff.) Harvey. Setchell & Gardner, 1903, p. 224; Collins, 1909, p. 336; Harvey, 1858, p. 77; P. B.-A., No. 817. Nanaimo, Harvey. This species rests entirely on Harvey's determination of the Lyall specimens. It is by no means unlikely that it is not identical with the Atlantic species bearing the same name.

C. STIMPSONI Harvey. Collins, 1909, p. 338; P. B.-A., No. 729. Nos. 140, 142, 149, 157, Ucluelet inlet, Macoun.

C. FLEXUOSA (Griff.) Harvey. Setchell & Gardner, 1903, p. 224; Collins, 1909, p. 339; Harvey, 1858, p. 78; P. B.-A., Nos. 1076, 1527. Victoria, Macoun; a slender form.

C. MICROCLADIOIDES Collins, 1909, p. 344. Little Torquit, Macoun.

C. LAETEVIRENS (Dillw.) Harvey. Setchell & Gardner, 1903, p. 224; Collins, 1909, p. 345; Harvey, 1858, p. 82; Fuca strait, Harvey. Only record; identity with Atlantic plant doubtful.

C. HUTCHINSIÆ var. DISTANS Kützing. Setchell & Gardner, 1903, p. 228; Collins, 1909, p. 345; Harvey, 1858, p. 83, as *C. diffusa*. Port Renfrew, Butler & Polley.

C. TRICHOTOMA (Ag.) Kützing. Setchell & Gardner, 1903, p. 226, as *C. columbiana;* Collins, 1909, p. 349; P. B.-A., No. 820. Amphitrite point, Macoun; Port Renfrew, Butler & Polley.

SPONGOMORPHA HYSTRIX Strömfelt. Setchell & Gardner, 1903, p. 225, as *Cladophora hystrix*; Collins, 1909, p. 358; P. B.-A., No. 982, as *Cladophora hystrix;* Tilden, Centuries, No. 374, as *Cladophora arcta* forma *b*. Gonzales point, Tilden.

S. ARCTA (Dillw.) Kützing. Setchell & Gardner, 1903, p. 224, as *Cladophora arcta;* Collins, 1909, p. 359; Harvey, 1858, p. 75, as *Cladophora arcta;* P. B.-A., Nos. 224, 815. Esquimalt, Harvey; Ucluelet, Macoun.

Forma CONGLUTINATA Collins. Setchell & Gardner, 1903, p. 224, under *Cladophora;* Collins, 1909, p. 359. Esquimalt, N. L. Gardner.

S. SAXATILIS (Rupr.) Collins. Setchell & Gardner, 1903, p. 223, as *Cladophora saxatilis;* Collins, 1909, p. 360; P. B.-A., No. 921. Ucluelet, Macoun.

S. SPINESCENS Kützing. Setchell & Gardner, 1903, p. 227, as *Cladophora spinescens;* Collins, 1909, p. 360; P. B.-A., No. 721, as *C. arcta* var. *centralis*. Ucluelet, Macoun.

S. COALITA (Rupr.) Collins. Setchell & Gardner, 1903, p. 227, as *Cladophora coalita;* Collins, 1909, p. 361; Harvey, 1858, p. 75, as *C. scopaeformis;* P. B.-A., No. 922.

BOODLEA COMPOSITA (Hook. & Harv.) Brand. Setchell & Gardner, 1903, p. 226, as *Cladophora composita;* Collins, 1909,

p. 367; P. B.-A., No. 722, as *C. composita.* Port Renfrew, Tilden.

Hormiscia penicilliformis (Roth) Fries. Setchell & Gardner, 1903, p. 220; Collins, 1909, p. 368; Harvey, 1858, p. 90, as *Hormotrichum speciosum;* P. B.-A., No. 18, as *Ulothrix isogona.* Port Renfrew, Butler & Polley; Esquimalt, N. L. Gardner; Departure bay, Macoun.

H. wormskjoldii (Mert.) Fries. Setchell & Gardner, 1903, p. 221; Collins, 1909, p. 368; Harvey, 1858, p. 91, as *Hormotrichum wormskjoldii;* P. B.-A., No. 915, as *Urospora wormskjoldii;* Tilden, Centuries, No. 31, as *U. wormskjoldii* var *vancouverensis.* Victoria, Tilden.[1]

Gomontia polyrhiza (Lagerh.) Bornet & Flahault. Setchell & Gardner, 1903, p. 229; Collins, 1909, p. 370; P. B.-A., No. 315. On barnacles, Quatrains, Macoun.

Halicystis ovalis (Lyng.) Areschoug. Setchell & Gardner, 1903, p. 232, as *Valonia ovalis;* Collins, 1909, p. 372. Port Renfrew, Butler & Polley.

Codium fragile (Suringar) Hariot forma californica (J. Ag.) Hariot. Setchell & Gardner, 1903, p. 232; Collins, 1909, p. 389; P. B.-A., No. 229; all as *C. mucronatum* forma *californicum;* Tilden, Centuries, No. 281, as *C. tomentosum.* Victoria, Departure bay, Amphitrite point, Macoun; Port Renfrew, Tilden.

Forma novae zelandiæ (J. Ag.) Collins. Setchell & Gardner, 1903, p. 232; Collins, 1909, p. 389; both as *C. mucronatum* forma *novae zelandiæ.* Port Renfrew, Butler & Polley.

C. adhærens (Cabr.) Agardh. Setchell & Gardner, 1903, p. 231; Collins, 1909, p. 387; P. B.-A., No. 523. Sooke, Macoun.

C. ritteri Setchell & Gardner, 1903, p. 231, Pl. XVII; Collins, 1909, p. 387; Tilden, Centuries, No. 370, as *C. adhærens.*

Bryopsis hypnoides Lamouroux. Setchell & Gardner, 1903, p. 230; Collins, 1909, p. 403; P. B.-A., Nos. 1028, 1286. Victoria, N. L. Gardner; on *Gracilaria confervoides*, Departure bay, Macoun.

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[1] No collections have come to notice of *Ulothrix* or *Chætomorpha;* there is every reason to suppose that they occur, but have been overlooked.

B. CORTICULANS Setchell. Setchell & Gardner, 1903, p. 230; Collins, 1909, p. 404; P. B.-A., No. 626. Ucluelet, Macoun.

PHÆOPHYCEÆ.

PYLAIELLA LITTORALIS (L.) Kjellman. Setchell & Gardner, 1903, p. 235; P. B.-A., Nos. 171, 414. Esquimalt, Harvey. A common and widely distributed species, appearing under many forms, of which we have the following:—

Var. FIRMA forma MACROCARPA (Foslie) Kjellman. Setchell & Gardner, 1903, p. 236; P. B.-A., No. 733; Victoria, Saunders; Departure bay, Macoun.

Var. VARIA (Kjellm.) Kuckuck. Setchell & Gardner, 1903, p. 236; P. B.-A., No. 669; Tilden, Centuries, No. 360, as *P. varia*. Victoria, Saunders; Port Renfrew, Tilden.

ECTOCARPUS SILICULOSUS (Dillw.) Lyngbye. Setchell & Gardner, 1903, p. 237; Harvey, 1852, p. 139; P. B.-A., Nos. 319, 1386. Esquimalt, Harvey.

E. CONFERVOIDES (Roth) LeJolis. Setchell & Gardner, 1903, p. 237; P. B.-A., No. 871. Port Renfrew, Butler & Polley.

Forma ACUMINATUS Collins & Setchell. Setchell & Gardner, 1903, p. 237; P. B.-A., Nos. 1033, 1127. Victoria, Gardner; Departure bay, Macoun.

Forma CORTICULATUS Saunders. Setchell & Gardner, 1903, p. 238; Ucluelet, Macoun.

E. MUCRONATUS Saunders. Setchell & Gardner, 1903, p. 238; Tilden, Centuries, No. 359b, as *E. granulosus*. Port Renfrew, Tilden.

E. GRANULOSUS (Eng. Bot.) Agardh. Setchell & Gardner 1903, p. 238; Harvey, 1852, p. 141. Victoria, Macoun. *E. oviger* Harvey is a form of this species, fide type in Herb. Harvey.

SPHACELARIA FUSCA Agardh. On various small algae, locality unknown. Macoun.

COILODESME CALIFORNICA (Rupr.) Kjellman. Setchell & Gardner, 1903, p. 241; P. B.-A., No. I; Tilden, Centuries, No. 522, as *Colpomenia sinuosa*. Esquimalt, Setchell; Victoria, Saunders, Macoun; Port Renfrew, Butler & Polley, Tilden.

COLPOMENIA SINUOSA (Roth) Derbes & Solier. Setchell & Gardner, 1903, p. 242; Harvey, 1852, p. 118, as *Asperococcus sinuosus*; P. B.-A., Nos. 278, 735. Port Renfrew, Butler & Polley.

SCYTOSIPHON LOMENTARIUS (Lyngb.) J. G. Agardh. Setchell & Gardner, 1903, p. 243; Harvey, 1852, p. 98, as *Chorda lomentaria*; P. B.-A., Nos. 323, 1235, 1389; Tilden, Centuries, No. 347b, as *Chordaria attenuata*. Departure bay, Macoun; Port Renfrew, Tilden; probably common everywhere.

PHYLLITIS FASCIA (Müll.) Kütz. Setchell & Gardner, 1903, p. 244; Harvey, 1852, p. 91, as *Laminaria fascia;* P. B.-A., Nos. 276, 736, 1131. Esquimalt, Harvey.

SORANTHERA ULVOIDEA Postels & Ruprecht. Setchell & Gardner, 1903, p. 244; P. B.-A., No. 417. Victoria, Saunders; Port Renfrew, Butler & Polley.[1]

DESMARESTIA ACULEATA (L.) Lamouroux. Setchell & Gardner, 1903, p. 246; Harvey, 1852, p. 78; P. B.-A., No. 129. Quite variable in habit, from the typical form of the Atlantic to a form hardly distinguishable from *D. viridis* (Müll.) Lamour. The latter species is reported from Esquimalt by Harvey, but it is probable that this is,

Forma MEDIA (Agardh) J. G. Agardh. Setchell & Gardner, 1903, p. 246; P. B.-A., No. 1036. More common than the type; abundant from Washington to Alaska. Victoria, Saunders; Departure bay, Ucluelet, Macoun; Port Renfrew, Butler & Polley.

D. LIGULATA (Turn.) J. G. Agardh. Seldom found as narrow as the typical European plant, chiefly,

Forma HERBACEA (Turn.) J. G. Agardh. Setchell & Gardner, 1903, p. 247; Harvey, 1852, p. 78; P. B.-A., No. LXXIX; Tilden Centuries, No. 244. Varying from a several times pinnate frond of moderate width, to a broad lamina with indistinctly dentate margin, up to 30cm. wide and several metres long.

DICTYOSIPHON FŒNICULACEUS (Huds.) Greville. Setchell & Gardner, 1903, p. 248; Harvey, 1852, p. 114; P. B.-A., No. 673. Ucluelet, Macoun. A common plant on both sides of the Atlantic, but apparently rare on this coast.

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[1] *Striaria attenuata* (Ag.) Greville is reported by Harvey, but there is no other record of its occurrence in the Pacific. The specimen in Herb. Harvey is in bad condition and undeterminable.

MYRIONEMA STRANGULANS Greville. Setchell & Gardner, 1903, p. 249; Harvey, 1852, p. 132; P. B.-A., Nos. 32, 924, 1689, as *M. vulgare;* Tilden, Centuries, No. 356, as *Phycocelis fœcunda.* Victoria, Tilden, on various membranaceous algæ.

LEATHESIA DIFFORMIS (L.) Areschoug. Setchell & Gardner, 1903, p. 249; Harvey, 1852, p. 129, as *L. tuberosa;* P. B.-A., Nos. 130, 829. Victoria, Saunders; Departure bay, Macoun.

MESOGLOIA ANDERSONII Farlow. Setchell & Gardner, 1903, p. 250; P. B.-A., No. 925. Port Renfrew, Butler & Polley; Ucluelet, Macoun.

M. SIMPLEX Saunders. Setchell & Gardner, 1903, p. 250; Tilden, Centuries, No. 349. Port Renfrew, Butler & Polley; Gonzales point, Tilden.

CHORDARIA ABIETINA Ruprecht. Setchell & Gardner, 1903, p. 251; P. B.-A., No. 281; Tilden, Centuries, No. 348; Victoria, Tilden; Port Renfrew, Butler & Polley.

CARPOMITRA CABRERÆ (Clem.) Kützing. Setchell & Gardner, 1903, p. 252. Straits of Juan de Fuca, Harvey. Lyall's collecting is the only record for this coast. As the species occurs in Europe, New Zealand, and Japan, there is no reason to question the record.

RALFIA DEUSTA (Agardh) J. G. Agardh. Setchell & Gardner, 1903, p. 253; Harvey, 1852, p. 130; P. B.-A., No. 419. Departure bay, Macoun; a reduced form.[1]

CHORDA FILUM (L.) Lamouroux. Setchell & Gardner, 1903, p. 254; Harvey, 1852, p. 98; P. B.-A., No. 831. Straits of Juan de Fuca, McMillan. Common in the Atlantic but apparantly rare here and at its southern limit for the Pacific.

LAMINARIA ANDERSONII Farlow. Setchell & Gardner, 1903, p. 255; P. B.-A., No. IV. Amphitrite point, Macoun.

L. BULLATA Kjellman, Setchell & Gardner, 1903, p. 257; P. B.-A., No. XXIX. Port Renfrew, Butler & Polley, Tilden. Appears under a considerable variety of forms, including:—

Forma SUBSIMPLEX Setchell & Gardner, 1903, p. 257; Tilden, Centuries, No. 239, as *L. digitata.* Esquimalt, Herb. J. G. Agardh.

Forma ANGUSTA Setchell & Gardner, 1903, p. 257; P. B.-A., No. LXXXV.

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[1] *R. verrucosa* (Areschoug) J. G. Agardh and *R. clavata* (Carm.) Farlow, widely distributed species, probably occur here but have been overlooked.

Forma AMPLISSIMA Setchell & Gardner, 1903, p. 258; P.B.-A., No. LXXXIV. Esquimalt, Harvey, as *L. dermatodea.*

Forma CUNEATA Setchell & Gardner, 1903, p. 258. Esquimalt, Harvey, as *L. dermatodea.* The specimens in Herb. Harvey marked *L. dermatodea* include the two last named forms.

L. SACCHARINA (L.) Lamouroux. Setchell & Gardner, 1903, p. 261; Harvey, 1852, p. 92; P. B.-A., No. XXXII. Victoria, Departure bay, Ucluelet, Macoun. Variable, passing into the two following forms which occur with the typical form:—

Forma COMPLANATA Setchell & Gardner, 1903, p. 262; P. B.-A., No. LXXXVII.

Forma MEMBRANACEA J. G. Agardh. Setchell & Gardner, 1903, p. 261.

L. EPHEREMA Setchell, 1901, p. 121; *Renfrewia parvula* Griggs, 1906, p. 247; Tilden, Centuries, No. 609, as *Renfrewia parvula.* Port Renfrew, Tilden.

HEDOPHYLLUM SESSILE (Ag.) Setchell & Gardner, 1903, p. 262; P. B.-A., No. VIII; Tilden, Centuries, No. 344, as *Laminaria sessilis.* Straits of Juan de Fuca, Harvey, as *L. apoda;* Esquimalt, Setchell, Macoun; Amphitrite point, Krawn cove, Macoun; Port Renfrew, Butler & Polley; Victoria, Tilden.[1]

CYMATHERE TRIPLICATA (Post. & Rupr.) J. G. Agardh. Setchell & Gardner, 1903, p. 264; P. B.-A., No. XXXIII; Tilden, Centuries, No. 343. Victoria, Tilden, Macoun; Esquimalt, Setchell.

PLEUROPHYCUS GARDNERI Setchell & Saunders. Setchell & Gardner, 1903, p. 264; P. B.-A., No. XC. Port Renfrew, McMillan.

COSTARIA TURNERI Greville. Setchell & Gardner, 1903, p. 265; Harvey, 1852, p. 90; P. B.-A., Nos. 631, XXXV. Victoria, Saunders; Esquimalt, Harvey; Port Renfrew, Butler & Polley; Amphitrite point, Departure bay, Macoun. Variable in texture, length of stipe and width of lamina.

AGARUM FIMBRIATUM Harvey. Setchell & Gardner, 1903, p. 266; P. B.-A., No. XCI. Esquimalt, Harvey. An interesting species, which seems to be limited to the Puget Sound region.

DICTYONEURON CALIFORNICUM Ruprecht. Setchell & Gardner, 1903, p. 267; P. B.-A., No. XI; Tilden, Centuries, No. 519.

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[1] *H. subsessile* Setchell is to be expected, but no specimens have so far been found.

Port Renfrew, Tilden; apparently the northern limit for this species.

LESSONIOPSIS LITTORALIS (Farlow & Setchell) Setchell & Gardner, 1903, p. 267; P. B.-A. No., XXXVII; Tilden, Centuries, No. 342, all as *Lessonia littoralis.* Port Renfrew, Tilden, Butler & Polley; Nos. 89, 90, on exposed rocks, Ucluelet inlet, Macoun.

POSTELSIA PALMÆFORMIS Ruprecht. Setchell & Gardner, 1903, p. 268; P. B.-A., Nos. 131, XXXVIII. Straits of Juan de Fuca, McMillan; Krawn cove, Macoun. Apparently the northern limit for this species.

MACROCYSTIS PYRIFERA (Turn.) Agardh. Setchell & Gardner, 1903, p. 270; Harvey, 1852, p. 84; P. B.-A., No. XXXIX; Tilden, Centuries, No. 518. Esquimalt, Harvey; Victoria, Macoun; Port Renfrew, Tilden.

NEREOCYSTIS LUETKEANA (Mert.) Postels & Ruprecht. Setchell & Gardner, 1903, p. 268; Harvey, 1852, p. 85; P. B.-A., No. X. Esquimalt, Harvey, Macoun; Port Renfrew, Butler & Polley.

EGREGIA MENZIESII (Turn.) Areschoug. Setchell & Gardner, 1903, p. 271; Harvey, 1852, p. 62, as *Phyllospora menziesii;* P. B.–A., No. XCII; Tilden, Centuries, No. 236. Nootka sound, Menzies; Esquimalt, Harvey; Victoria, Tilden; Port Renfrew, Butler & Polley.

PTERYGOPHORA CALIFORNICA Ruprecht. Setchell & Gardner, 1903, p. 271; MacMillan, 1902, p. 723; P. B.–A. No. CVIII; Tilden, Centuries, No. 520. Port Renfrew, Tilden.

ALARIA MARGINATA Postels & Ruprecht. Setchell & Gardner 1903, p. 275, also *A. prælonga* and *A. laticosta*; P. B.–A., No. XLIV, as *A. lanceolata; A. curtipes* Saunders, 1901, p. 561, Pl. XXXIII. Esquimalt, Harvey; Victoria, Amphitrite point, Krawn cove, Macoun.

Forma **Nana** (Schrader) nov. comb.; *A. prælonga* forma *nana* Setchell in P. B.–A., No. 1292; *A. nana* Schrader, 1903, p. 157.

A. GRANDIFOLIA J. G. Agardh. Setchell & Gardner, 1903, p 278, as *A. valida*; P. B.–A., No. CV. Amphitrite point Macoun.

A. TENUIFOLIA Setchell—forma AMPLIOR Setchell & Gardner, 1903, p. 274. Esquimalt, Gardner. The *A. pylaii* of the Lyall collection belongs here, fide specimen in Herb. Harvey. Under this species should probably be included the plant from Port Renfrew, distributed by Miss Tilden in Centuries, No. 214b, as *A. cordata.*

FUCUS EVANESCENS Agardh. Setchell & Gardner, 1903, p. 281; P. B.–A., No. XIV. Common and variable; including:—

Forma CORNUTUS Kjellman. Setchell & Gardner, 1903, p. 283; P. B.–A., No. 927. Esquimalt, Gardner; Victoria, Macoun.

Forma PERGRANDIS Kjellman. Setchell & Gardner, 1903, p. 284; P. B.–A., No. CXI. Port Renfrew, Butler & Polley; Victoria, Macoun.

Forma MACROCEPHALUS Kjellman. Setchell & Gardner, 1903, p. 282; P. B.–A., No. CX. Ucluelet, Macoun. Intermediate forms were collected at Departure bay, Macoun.

F. INFLATUS (L.) Vahl. Setchell & Gardner, 1903, p. 280. Another very variable species, including:—

Forma LINEARIS (Oed.) Rosenvinge. Setchell & Gardner, 1903, p. 280. Departure bay, Macoun.

Forma FILIFORMIS (Gmelin) Setchell & Gardner, 1903, p. 281; P. B.–A., No. 233, as *Fucus filiformis.* Ucluelet, Macoun.

Forma EDENTATUS (DelaPyl.) Rosenvinge. Setchell & Gardner, 1903, p. 280; P. B.–A., No. XIII, as *Fucus edentatus;* Tilden, Centuries, No. 234, as *F. furcatus.* Victoria, Tilden.

PELVETIOPSIS LIMITATA (Setchell) Gardner, 1910, p. 127. P. B.–A., No. 1238, as *Pelvetia fastigiata* forma *limitata.* Quatrains, Macoun.

CYSTOPHYLLUM GEMINATUM (Ag.) J. G. Agardh. Setchell & Gardner, 1903, p. 285; P. B.–A., No. XLVII, as *Cystoseira lepidium.* Banks island, Harvey; Port Renfrew, Butler & Polley; Victoria, Ucluelet, Macoun.

RHODOPHYCEÆ.

BANGIA FUSCOPURPUREA Lyngbye. Setchell & Gardner, p. 288, as *B. atropurpurea* forma *fuscopurpurea;* P. B.–A., Nos. 87, 1134; Tilden, Centuries, No. 333, as *B. vermicularis.* Port Renfrew, Butler & Polley, Tilden; Victoria, Saunders. Probably generally distributed. On a *Ceramium* from Port Renfrew, Butler & Polley, is a delicate form which may be a young state of this species, or may be distinct. Nothing being known of its development, no decision can be reached.

PORPHYRA UMBILICALIS Setchell & Gardner, 1903, p. 289; P. B.–A., No. 1086. Victoria, Departure bay, Macoun.

P. PERFORATA J. G. Agardh. Setchell & Gardner, 1903, p. 289; Hus. 1902, p. 202; P. B.–A., No. 682. Esquimalt, Harvey, as *P. vulgaris*, fide specimen in Herb. Harvey; Departure bay, Victoria, Cape Lazo, Macoun; Port Renfrew, Butler & Polley. Apparently the most frequent species of the genus in this region; generally of the typical form, but occasionally passing into,

Forma SEGREGATA Setchell & Hus. Setchell & Gardner, 1903, p. 290; Hus. 1902, p. 207; P. B.–A., No. 684.

P. NEREOCYSTIS Anderson. Setchell & Gardner, 1903, p. 290; Hus. 1902, p. 210; P. B.–A., No. 583. Victoria, Macoun.

P. NAIADUM Anderson forma MAJOR Hus., 1902, p. 213; Setchell & Gardner, 1903, p. 290; P. B.–A., No. 875. Victoria, Macoun.

Forma MINOR Hus. 1902, p. 213; Setchell & Gardner, 1903, p. 290; P. B.–A., No. 632; Tilden, Centuries, No. 516. Port Renfrew, Butler & Polley, Tilden. The two forms, *major* and *minor*, represent extremes, between which there are intermediates. There is no typical form distinct from them.

P. ABYSSICOLA Kjellman. Setchell & Gardner, 1903, p. 291; Hus. 1902, p. 223. Victoria, Macoun.

P. AMPLISSIMA (Kjellman) Setchell & Hus. Setchell & Gardner, 1903, p. 290; Hus., 1902, p. 215; P. B.–A., No. XLIX (Nos. 45, 61) Amphitrite point, Ucluelet. Macoun. Specimens fragmentary and somewhat doubtful.

P. MINIATA forma CUNEIFORMIS Setchell & Hus. Setchell & Gardner, 1903, p. 291; Hus., 1902, p. 218; P. B.–A., No. 929; Tilden, Centuries, No. 230. Victoria, Tilden.

P. VARIEGATA Kjellman. Setchell & Gardner, 1903, p. 291; Hus, 1902, p. 225; P. B.–A., No. 930. Victoria, G. W. Lichtenthaler.

ERYTHROTRICHIA CERAMICOLA (Lyngb.) Areschoug. Setchell & Gardner, 1903, p. 292; P. B.–A., No. 1642.

Amphitrite point, Ucluelet. (93.) Macoun.

CHANTRANSIA MONILIFORMIS Rosenvinge, 1909, p. 99, fig. 28. Qualicum, Macoun. A diminutive form, even for this genus; specially characterized by the short, moniliform cells. It grew among other epiphytes on *Polysiphonia subulata.*

C. HALLANDICA Kylin, 1906, p. 123; P. B.-A., No. 1796. This species as found in Europe varies considerably; the Vancouver form is not exactly like any of the European forms but the differences are not sufficiently clear to justify a varietal or form name.

C. Macounii n. sp. Cæspitosa, monoica (interdum dioica?), ad 2 mm. alta, sine disco basali aut cellula distincta basali: filamentis rhizoideis affixa, inter fila peripherica plantæ hospitis currentibus; filamentis principalibus erectis, circa 8μ diam.; cellulis circa 4 diam. longis; ramis principalibus similibus, paucis, longis, virgatis, ramulos multos, breves, saepe ad cellulas omnes rami gerentibus, alternates, oppositos vel secundos; ramulorum cellulis 1–1½ diam. longis; antheridiis ovoideis, 4 × 5μ, circa axes breves a ramulis surgentes, dense verticillatis; cystocarpio sporas 2–3, 10 × 15μ, gerente, ramulo insidenti vel ramuli locum occupante; sporangiis carposporis similibus, in ramos et ramulos, pedicello unicellulari suffultis; sporis indivisis.

Tufted, monœcious (sometimes diœcious?), up to 2 mm. high, without basal disk or distinct basal cell; attached by rhizoidal filaments, running between the peripheral filaments of the host plant; main filaments erect, about 8μ diam., cells about 4 diam. long; main branches similar, few, long, virgate, bearing many short ramuli, often one to each cell of the branch, alternate, opposite or secund; cells of the ramuli 1-1½ diam. long; antheridia ovoid, 4 × 5μ, densely whorled about short axes arising from the ramuli; cystocarp producing 2-3 spores, 10 × 15μ, on or occupying the place of a ramulus; sporangia similar to the carpospores, on branches or ramuli, on unicellar pedicel; spores undivided. On *Mesogloia andersonii*, Macoun.

The antheridia were more abundant than the cystocarps in the material examined; in many individuals antheridia only were to be found, but plants with cystocarps bore also antheridia. The descending rhizoidal filaments are few, and run parallel with the peripheral filaments of the host, barely entering the central layer. Even with the largest tufts, in full fruit, no filaments other than these were seen, either on the surface or in the interior of the host. The species seems nearly related to *C. nemalionis* (De Not.) Ardissone & Straforello, but is smaller in all dimensions and with much less developed endophytic portion, and the main filaments are densely set throughout with short ramuli; sexual organs are abundant in *C. macounii*, but unknown in *C. nemalionis*.

SCINAIA FURCELLATA (Turn.) Bivona var UNDULATA (Mont.) J. G. Agardh. P. B.-A., No. 422. Ucluelet, Macoun.

GELIDIUM AMANSII Lamouroux. Setchell & Gardner, 1903, p. 295; P. B.-A. No. 585; Tilden, Centuries, No. 513, as *G. latifolium*. Ucluelet, Departure bay, Victoria, Macoun; Port Renfrew, Tilden. Mostly much smaller plants than are found on the California coast.

G. CRINALE (Turn.) J. G. Agardh. P. B.-A., No. 195. Victoria, Macoun. There is much uncertainty as to species of this genus, and it is likely that several species will some time be made from what now passes as *G. crinale*.

ENDOCLADIA MURICATA (Harv.) J. G. Agardh. Setchell & Gardner, 1903, p. 296; Harvey, 1853, p. 182; P. B.-A., Nos. 138, 882. Esquimalt, Harvey; Port Renfrew, Butler & Polley; Sooke, Amphitrite point, Victoria, Macoun.

Forma INERMIS, Setchell & Gardner, 1903, p. 297; P. B.-A. No. 1090. Esquimalt, Harvey.

CHONDRUS AFFINIS Harvey. Setchell & Gardner, 1903, p. 298; Harvey, 1853, p. 181; P. B.-A., No. 424. Esquimalt, Harvey.

CHONDRUS CRISPUS (L.) Lyngbye. Setchell & Gardner, 1903, p. 297; Harvey, 1853, p. 181; P. B.-A., Nos. 488, 785. Victoria, Macoun.

GYMNOGONGRUS NORVEGICUS (Turn.) J. G. Agardh. Harvey, 1853, p. 166; P. B.-A., No. 381. (856?) On rocks, Ucluelet inlet, Macoun. This is the first record of this species on the Pacific coast; the specimens are quite indistinguishable from the plant as it occurs on both sides of the Atlantic.

IRIDÆA LAMINARIOIDES Bory. Setchell & Gardner, 1903, 298; Harvey, 1853, p. 179; P. B.-A., Nos. 91, XVI. Port

Renfrew, Butler & Polley; Victoria, Macoun. The typical form seems to be common at these stations.

Forma PARVULA Kjellman. Setchell & Gardner, 1903, p. 299; P. B.-A., No. 931. Departure bay, Macoun.

Forma CORDATA (Turn.) Setchell & Gardner, 1903, p. 299; Harvey, 1853, p. 180, as *I. cordata*; Tilden, Centuries, No. 328, as *I. laminarioides*. Port Renfrew, Butler & Polley; Esquimalt, Harvey.

Forma PUNICEA (Post. & Rupr.) Setchell & Gardner, 1903, p. 300; Harvey, 1853, p. 180, as *I. punicea*; P. B.-A., No. CXXII. Victoria, Departure bay, Comox, Macoun.

Forma MINOR (J. Ag.) Setchell. Harvey, 1853, p. 179, as *I. minor;* P. B.-A., No. 587. Victoria, Macoun.

This species varies much, and intermediate forms to which it is impossible to assign definite names are very common.

GIGARTINA MAMILLOSA (Good. & Woodw.) J. G. Agardh. Setchell & Gardner, 1903, p. 301; Harvey, 1853, p. 175. This species also varies much in the form of the frond; three forms may be distinguished with some clearness, but there is no reason to consider one of them more typical than the others.

Forma VULGARIS Harvey, 1862, p. 172; Setchell & Gardner, 1903, p. 302, as *G. mamillosa* forma *dissecta;* P. B.-A., No. 427, as *G. papillata* forma *dissecta*. Esquimalt, Harvey; Port Renfrew, Butler & Polley; Amphitrite point, Macoun.

Forma LATISSIMA Harvey, 1862, p. 172; Setchell & Gardner, 1903, p. 301, as *G. mamillosa* forma *cristata;* P. B.-A., No. 426, as *G. papillata* forma *cristata*. Esquimalt, Harvey; Port Renfrew, Butler & Polley; Victoria, Sooke, Departure bay, Macoun.

Forma SUBSIMPLEX Setchell. Setchell & Gardner, 1903, p. 302; P. B.-A., No. 425, as *G. papillata* forma *subsimplex*. Victoria, Macoun.

G. EXASPERATA, Harvey & Bailey. Setchell & Gardner, 1903, p. 303; as *G. radula* var. *exasperata;* Harvey, 1853, p. 177, P. B.-A., No. XVIII, as *G. radula* forma *exasperata*. Port Renfrew, Butler & Polley; Victoria, Harvey; Departure bay, Cape Lazo, Sooke, Macoun.

Forma **Microphylla** (Harvey) nov. comb. Setchell & Gardner, 1903, p. 303, as *G. radula* forma *microphylla*; Harvey, 1853, p. 176, as *G. microphylla;* P. B.-A., No. XIX, as *G. radula* forma *microphylla*. Cape Lazo, Macoun.

ERYTHROPHYLLUM DELESSERIOIDES J. G. Agardh. Setchell & Gardner, 1903. p. 303; P. B.-A., Nos. 50, 588; Tilden, Centuries, No. 504. Port Renfrew, Butler & Polley, Tilden; Victoria, Macoun.

AHNFELDTIA PLICATA (Huds.) Fries. Setchell & Gardner, 1903, p. 305; Harvey, 1853, p. 168; P. B.-A., No. 743. Esquimalt, Harvey; Port Renfrew, Butler & Polley; Departure bay, Victoria, Brackley point, Macoun.

A. CONCINNA J. G. Agardh. Setchell & Gardner, 1903, p. 305; Harvey, 1853, p. 168, as *A. gigartinoides;* P. B.-A., No. 430. Port Renfrew, Butler & Polley.

STERROCOLAX CRASSIOR Schmitz. Setchell & Gardner, 1903, p. 305. Port Renfrew, Butler & Polley; Brackley point, Macoun. Parasitic on *Ahnfeldtia plicata.*

CALLOPHYLLIS FURCATA Farlow. Setchell & Gardner, 1903, p. 306; P. B.-A., No. 883. Port Renfrew, Butler & Polley. *C. laciniata* Harvey from Esquimalt should probably be referred to this species.

Forma DISSECTA Farlow. Setchell & Gardner, 1903, p. 306; Tilden, Centuries, No. 325, as *C. obtusifolia.* Port Renfrew, Butler & Polley, Tilden; Victoria, Macoun.

C. FLABELLULATA Harvey. Setchell & Gardner, 1903, p. 306. Esquimalt, Macoun; Victoria, Lichtenthaler.

C. VARIEGATA (Bory) Kützing. Setchell & Gardner, 1903, p. 307. Esquimalt, Harvey.

CALLYMENIA PHYLLOPHORA, J. G. Agardh. Setchell & Gardner, 1903, p. 308; Tilden, Centuries, No. 324, as *C. californica.* "Vancouver island", J. G. Agardh; Port Renfrew, Tilden.

Forma ORBICULARIS Setchell & Gardner, 1903, p. 308. Port Renfrew, Butler & Polley.

C. ORNATA (Post. & Rupr.) J. G. Agardh. Setchell & Gardner, 1903, p. 307. Departure bay, Macoun.

C. RENIFORMIS (Turn.) J. G. Agardh. Setchell & Gardner, 1903, p. 307. Esquimalt, Harvey. So many forms of *Callymenia* have been distinguished since Harvey's time, that there must be some doubt as to the determination of the Lyall plant. A specimen from Departure bay, Macoun, is quite like the *C. reniformis* of the California coast.

AGARDHIELLA TENERA (J. Ag.) Schmitz. Setchell & Gardner, 1903, p. 309; Harvey, 1853, p. 154, as *Rhabdonia coulteri;* P. B.-A., No. 333, as *Agardhiella coulteri.* Esquimalt, Harvey; Victoria, Departure bay, Macoun. *Cystoclonium gracilarioides* was reported from Esquimalt by Harvey; the type specimen in Herb. Harvey proves to be *Agardhiella tenera. Eucheuma nudum,* as reported from this region, probably is a synonym.

TURNERELLA MERTENSIANA (Post. & Rupr.) Schmitz. Setchell & Gardner, 1903, p. 309. Victoria, Harvey, as *Iridea mertensiana;* but there is possibly some doubt as to this.

ANATHECA FURCATA Setchell & Gardner, 1903, p. 310, Plates XXIII, XXIV; P. B.-A., No. 932. Departure bay, dredged, Macoun.

EUTHORA FRUTICULOSA (Rupr.) J. G. Agardh. Setchell & Gardner, 1903, p. 311; Victoria, Macoun.

GRACILARIA CONFERVOIDES (L.) Greville. Setchell & Gardner, 1903, p. 312; Harvey, 1853, p. 108; P. B.-A., Nos. 384, 1041. Esquimalt, Harvey; Departure bay, Macoun. The Departure Bay plant is a small form; the station is probably near the northern limit for the species.

FAUCHEA LACINATA J. G. Agardh. Setchell & Gardner, 1903, p. 313. On rocks at low tide, Amphitrite point, Ucluelet, (155) Macoun.

RHODYMENIA PALMATA (L.) Greville. Setchell & Gardner, 1903, p. 314; Harvey, 1853, p. 148; P. B.-A., No. 591. Esquimalt, Harvey; Amphitrite point, Macoun. The plant from the latter locality is of the typical form, that from the former presumably so.

Forma MOLLIS Setchell & Gardner, 1903, p. 315; P. B.-A., No. 934; Tilden, Centuries, No. 304. Esquimalt, Tilden; Amphitrite point, Victoria, Macoun. Passes imperceptibly into the typical form.

R. PALMETTA (Esp.) Greville. Setchell & Gardner, 1903, p. 316; Harvey, 1853, p. 149. This is doubtful; it is reported by Harvey, and a specimen from Amphitrite point, Macoun, might very well pass for this species. Unfortunately it is young and sterile; in this condition *R. palmetta* cannot be distinguished with certainty from *R. corallina.*

R. CORALLINA (Bory) Greville. Setchell & Gardner, 1903, p. 316. Straits of Juan de Fuca, Harvey; Ucluelet, Macoun.

R. FLABELLIFOLIA Bory. Victoria, Macoun. This and the preceding species are not easily distinguished; moreover, in the sterile state both are hard to distinguish from *Stenogramme interrupta.*

R. PERTUSA (Post. & Rupr.) J. G. Agardh. Setchell & Gardner, 1903, p. 313; Harvey, 1853, p. 147; P. B.-A., No. L. Port Renfrew, Butler & Polley; Victoria, Qualicum, Port Holmes, Macoun.

CHRYSYMENIA PSEUDODICHOTOMA Farlow. P. B.-A., No. 139. A fragment without definite locality. Macoun.

LOMENTARIA OVALIS forma SUBARTICULATA (Turn.) Harvey. Setchell & Gardner, 1903, p. 316; Harvey, 1853, p. 78; P. B.-A., No. 433, as *L. ovalis* var. *Coulteri.* "North Sound," Menzies; Ucluelet, Kavarnos, Macoun.

PLOCAMIUM COCCINEUM (Huds.) Lyngbye. Setchell & Gardner, 1903, p. 317; Harvey, 1853, p. 153; P. B.-A., No. 994. Straits of Juan de Fuca, Harvey; Port Renfrew, Butler & Polley; Departure bay, Comox, Sooke, Victoria, Macoun.

P. VIOLACEUM Farlow. Setchell & Gardner, 1903, p. 317; P.B.-A., No. 542. Port Renfrew, Butler & Polley; (211) Ucluelet inlet, Macoun.

HALOSACCION GLANDIFORME (Gmelin) Reprecht. Setchell & Gardner, 1903, p. 317; Harvey, 1853, p. 194; P. B.-A., No. 249, both as *H. hydrophora;* Tilden, Centuries, No. 511, as *H. fucicola.* Departure bay, Esquimalt, Macoun; Port Renfrew, Butler & Polley, Tilden.

NITOPHYLLUM RUPRECHTIANUM J. G. Agardh. Setchell & Gardner, 1903, p. 321; Harvey, 1853, pp. 100 and 102, as *Hymenena fimbriata* and *Botryoglossum platcarpum;* P. B.-A., No. 937. Port Renfrew, Butler & Polley; Departure bay, Ucluelet, Port Holmes, etc., Macoun.

Forma FLABELLIGERUM (J. G. Agardh) Nott. Setchell & Gardner, 1903, p. 321. Departure bay , Port Holmes, Macoun.

A common species and variable as well in the position of the fructification as in the size and form of the frond.

N. LATISSIMUM (Harv.) J. G. Agardh. Setchell & Gardner, 1903, p. 320; P. B.-A., No. 335. Esquimalt, Harvey, as *Hymenena latissima;* Gordon Head, Victoria, Macoun.

N. VIOLACEUM J. G. Agardh. Setchell & Gardner, 1903, p. 321; P. B.-A., No. 389; Tilden, Centuries, No. 321, as *N. multilobum.* Esquimalt, J. G. Agardh, as *N. stenoglossum;* Departure bay, Macoun; Port Renfrew, Tilden.

N. SPECTABILE Eaton. Esquimalt, Harvey, fide specimen in Herb. Harvey; a single specimen among those marked *Hymenena fimbriata,* the others being *Nitophyllum ruprechtianum.*

SCHIZONEURA QUERCIFOLIA (Bory) J. G. Agardh. P. B.-A., No. 434, as *Delesseria quercifolia.* Macoun.

ERYTHROGLOSSUM WOODII J. G. Agardh. Victoria, J. G. Agardh, a doubtful species.

APOGLOSSUM DECIPIENS J. G. Agardh. Setchell & Gardner, 1903, p. 323; P. B.-A., No. 1141. Vancouver island, J. G. Agardh; Fuca straits, Harvey, as *Delesseria hypoglossum* var. *arborescens.*

PTERIDIUM SERRATUM (Post. & Rupr.) De Toni. Setchell & Gardner, 1903, p. 324; Harvey, 1853, p. 95, as *Delesseria serrata*; P. B.-A., No. 938, as *D. quercifolia* forma *linearis.* Port Renfrew, Butler & Polley.

P. ALATUM (Huds.) J. G. Agardh. Setchell & Gardner, 1903, p. 324. Victoria, Saunders; Esquimalt, Harvey, as *Delesseria alata* var. *latissima.* It is doubtful if this form is identical with the *Delesseria alata* of Europe.[1]

BONNEMAISOMIA HAMIFERA Hariot. Setchell & Gardner, 1903, p. 325; P. B.-A., No. 939. Victoria, Macoun.

POLYSIPHONIA URCEOLATA (Lightf.) Greville. Setchell & Gardner, 1903, p. 326; Harvey, 1853, p. 32; P. B.-A., Nos. 748, 1697. Esquimalt, Harvey; Port Renfrew, Butler & Polley.

Var. **Senticulosa** (Harv.) nov. comb. Setchell & Gardner, 1903, p. 327, as *P. senticulosa.* Esquimalt, Harvey; Orcas, Qualicum, Victoria, Macoun. Extreme forms of the variety seem quite distinct from typical *P. urceolata,* but they pass into each other so frequently that *P. senticulosa* cannot be maintained as a species.

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[1] The genera *Schizoneura, Erythroglossum, Apoglossum* and *Pteridium* are segregates of the old genus *Delesseria,* and their values as well as the names they should bear, are still uncertain.

P. TENUISTRIATA Hooker & Harvey, 1844, p. 479, Pl. CLXXXIII, fig. 3; Setchell & Gardner, 1903, p. 327; P. B.-A., No. 1142, both as *P. californica;* Esquimalt, Harvey, as *P. atrorubescens.* Victoria, Macoun. This form, considered by Harvey as identical with *P. atrorubescens* of the Atlantic, was referred by Falkenberg to *P. californica* Harvey, but an examination of the type in Herb. Harvey shows that the latter cannot be distinguished from *Pterosiphonia bipinnata,* while authentic material of *P. tenuistriata* agrees well with the plant in question, which has a range from Vancouver to Southern California.

P. NIGRESCENS (Huds.) Greville var. AFFINIS (Moore) Harvey. P. B.-A., No. 596. Departure bay, Macoun.

P. SUBULATA (Ducl.) J. G. Agardh. P. B.-A., No. 638, as *P. senticulosa.* Victoria, Qualicum, Macoun. This species seems to range from Vancouver to southern California; it is somewhat variable, the Vancouver form being stouter, and with uniformly shorter segments than the plant from Southern California distributed as P. B.-A., No. 638. Both forms are found in Europe.[1]

LAURENCIA PINNATIFIDA (Gmel.) Lamouroux. Setchell & Gardner, 1903, p. 326; Harvey, 1853, p. 70; P. B.-A., No. 543; Tilden, Centuries, No. 320. Victoria, Harvey; Port Renfrew, Butler & Polley; Ucluelet, Amphitrite point, Departure bay, Macoun.

JANCZEWSKIA VERRUCÆFORMIS Solms. Setchell & Gardner, 1903, p. 326; P. B.-A., No. 887. On *Laurencia pinnatifida,* Victoria, Macoun. Only one species of this genus has yet been reported on the Pacific coast. There is reason to believe that there are at least two others, but until the distinctions are clearly made out, the present name may be provisionally used.[2]

PTEROSIPHONIA PLUMULA (J. Ag.) Collins in P. B.-A., No. 1789. Victoria, Macoun. A delicate plant with short, feathery fronds, the branches issuing from each segment of the rachis; in herbaria it has sometimes been labelled *Polysiphonia dictyurus,* but the latter is a true *Polysiphonia.* The Vancouver plants are more slender than the type of *Polysiphonia plumula* in Herb. J. Ag., which is from southern California, but otherwise they are the same.

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[1] The genus *Polysiphonia,* as now limited, seems to be rather poorly represented on the west coast of America, while such genera as *Pterosiphonia, Lophosiphonia* etc., segregated from the old *Polysiphonia,* are better represented.

[2] *Chondria atropurpurea* is reported by Harvey from "Fuca Strait". The specimen in Herb. Harvey is not in good condition, but is probably *Cryptosiphonia woodii.*

P. BIPINNATA (Post. & Rupr.) Falkenberg. Setchell & Gardner, 1903, p. 328; Harvey, 1853, p. 48, as *Polysiphonia californica;* P. B.-A., No. 144, as *Polysiphonia bipinnata.* Departure bay, Comox, Victoria, Gordon Head, Macoun; Port Renfrew, Butler & Polley. Under this must be included the following species of the Lyall Collection: *Polysiphonia californica* and var. *plumigera, P. bipinnata* and var. *gemmifera.*

P. PARASITICA (Huds.) Falkenberg. Setchell & Gardner, 1903, p. 328, as *P. dendroidea;* P. B.-A., No. 642, as *P. parasitica* var. *dendroidea.* Esquimalt, Harvey, as *Polysiphonia dendroidea;* Victoria, Comox, Macoun. Represented here by two forms:—

Forma **Borealis** n. f., more slender and less branched than the European type.

Forma **Luxurians** n. f., broader, several times pinnate.

The typical form is intermediate and has not been reported here.

P. WOODII (Harv.) Falkenberg. Setchell & Gardner, 1903, p. 329; Harvey, 1853, p. 52, as *Polysiphonia woodii;* P. B.-A., No. 1545. Port Renfrew, Butler & Polley; Ucluelet, Macoun. The Ucluelet material includes male plants, not before recorded for this species; antheridia have been found in only a few species of *Pterosiphonia,* and in these do not differ from those of *Polysiphonia,* the spermatangia being closely set all around an erect axis, the whole having a conical form. In *P. woodii* the spermatangia are placed on the edge of a flat cellular disk, but not on the surface. The antheridia of *Chondria* are similar, but the disk is undulate and wavy, not flat. It may be that this species should be removed from *Pterosiphonia,* but antheridial characters have been so little used in specific or generic distinctions, that it may be well to make no change until more is known of their significance and permanence.

LOPHOSIPHONIA VILLUM (J. Ag.) Setchell & Gardner, 1903, p. 329. (243) Departure bay, Macoun. Forming a short, dense, plushlike coating on rocks and algae. It is the *Polysiphonia villum* of Alg. Am.-Bor. Exsicc., No. 134 bis., but not of P. B.-A., No. 246.

L. OBSCURA (Ag.) Falkenberg. Setchell & Gardner, 1903, p. 329; P. B.-A., No. 1096, not 1600. (243) Departure bay, Macoun. In similar stations to the preceding species, but taller and looser, and with 10-18 pericentral cells, while *L. villum* has four only.

RHODOMELA LYCOPODIOIDES (L.) Agardh. A very variable circumpolar species, represented here by,

Forma TENUISSIMA (Rupr.) Kjellman. Setchell & Gardner, 1903, p. 332. Port Renfrew, Butler & Polley; Victoria, Cape Lazo, Macoun.

R. LARIX (Turn.) Agardh. Setchell & Gardner, 1903, p. 330; Harvey, 1853, p. 24; P. B.-A., Nos. 241, 1699. Esquimalt, Harvey; Amphitrite point, Victoria, Macoun; Port Renfrew, Butler & Polley.

ODONTHALIA FLOCCOSA (Esper) Falkenberg. Setchell & Gardner, 1903, p. 333; Harvey, 1853, p. 24, as *Rhodomela floccosa;*. Victoria, Departure bay, Macoun; Fuca strait, Harvey. A very variable species; besides the typical form we have:—

Forma COMOSA Setchell & Gardner, 1903, p. 334, Pl. XXVII, fig. 50. Departure bay, Ucluelet, Macoun; Port Renfrew, Butler & Polley.

Forma MACRACANTHA (Kütz.) Setchell & Gardner, 1903, p. 335. Port Renfrew, Butler & Polley.

O. LYALLII (Harv.) J. G. Agardh. Setchell & Gardner, 1903, p. 335; P. B.-A., No. 940; Tilden, Centuries, No. 319, as *Laurencia grevilleana.* Fuca strait, Harvey, as *Rhodomela lyallii*; Victoria, Cape Lazo, Macoun.

O. KAMTSCHATICA (Rupr.) J. G. Agardh. Setchell & Gardner, 1903, p. 336. Vancouver, Lichtenthaler; Victoria, Macoun; Port Renfrew, Butler & Polley.

O. ALEUTICA (Ag.) J. G. Agardh. Setchell & Gardner, 1903, p. 333; P. B.-A., No. 1147; Tilden, Centuries, Nos. 314, 315, as *Rhodomela floccosa.* Victoria, Qualicum, Macoun; Port Renfrew, Butler & Polley.

O. SEMICOSTATA Setchell & Gardner, 1903, p. 336, Pl. XXVI, XXVII; P. B.-A., No. 941; Tilden, Centuries, No. 312, as *O. dentata.* Victoria, Macoun. There is a question as to whether this plant is the same as *O. semicostata* of Mertens. It is certainly the plant described under that name by Setchell & Gardner, and distributed in P. B.-A., No. 941.

The Pacific coast forms of *Rhodomela* and *Odonthalia* are all quite variable and there is confusion in the determination by various writers. The following key may be useful as explaining how they are understood by the writer.

1. Branching spiral, not distichous. Rhodomela. 2.
1. Branching distichous. Odonthalia. 3.
  2. Main axes long, virgate; ultimate axes short, densely branched. *R. Larix.*
  2. Little distinction between axes of different orders. *R. lycopodioides.*
3. Organs of fructification in dense glomerules. 4.
3. Organs of fructification looser, in racemes. 7.
  4. Rachis and branches all flat. *O. semicostata.*
  4. Rachis terete or compressed. *O. floccosa.* 5.
5. Branchlets long, slender, recurved, numerous. Forma *comosa.*
5. Branchlets less differentiated. 6.
  6. Branching rather loose. Forma *typica.*
  6. Branching quite loose and coarse. Forma *macracantha.*
7. Midrib distinct. *O. kamtschatica.*
7. Midrib wanting or quite indistinct. 8.
  8. Rachis and branches sinuous; organs of fructification erect and subdistant. *O. lyallii.*
  8. Rachis and branches straight; organs of fructification appressed. *O. aleutica.*

Dasyopsis plumosa (Harv. & Bail.) Falkenberg. Setchell & Gardner, 1903, p. 337; P. B.-A., No. 942. Comox, Ucluelet, Qualicum, Queen Charlotte sound, Macoun. A very handsome plant, limited to the Pacific coast of North America, extending south along most of California.

Griffithsia schousboei Montagne. Tilden, Centuries, No. 208, as *G. opuntioides*, specimen from Washington; Little Torquit, Macoun. Probably several species of *Griffithsia* occur on the west coast of North America, but it is very seldom that they are found in fruit, and specific determination is doubtful. The identity of the present form with the European plant of the same name seems, however, pretty well made out.

PLEONOSPORIUM VANCOUVERIANUM J. G. Agardh. Setchell & Gardner, 1903, p. 338. Vancouver island, J. G. Agardh; Esquimalt, Harvey, as *Callithamnion thuyoideum.*

CALLITHAMNION POLYSPERMUM Agardh. Setchell & Gardner, 1903, p. 338 ; Harvey, 1853, p. 234. Vancouver island, J. G. Agardh; Esquimalt, Harvey; Departure bay, Victoria, on *Gelidium* and *Ahnfeldtia*, Macoun. This species has been reported from many localities, temperate and subtropical; it is not unlikely that further study may show that a group of nearly related species has been passing under this name.[1]

CERATOTHAMNION PIKEANUM (Harv.) J. G. Agardh, forma LAXUM Setchell & Gardner, 1903, p. 339; Harvey, 1853, p. 230, as *Callithamnion pikeanum;* P. B.-A., No. 943. Esquimalt, Harvey, as *C. arbuscula* var. *pacificum;* Victoria, Macoun.

PTILOTA FILICINA J. G. Agardh. Setchell & Gardner, 1903, p. 340; P. B.-A., No. 643; Harvey, 1853, p. 222, as *P. californica* var. *concinna.* Victoria, Macoun; Port Renfrew, Butler & Polley; Esquimalt, Harvey, fide specimen in Herb. Harvey, as *P. californica.*

P. HYPNOIDES Harvey, 1853, p. 220; P. B.-A., No. 599. Port Renfrew, Butler & Polley.

P. CALIFORNICA Ruprecht. Setchell & Gardner, 1903, p. 340; P. B.-A., No. 547; Tilden, Centuries, No. 307, as *P. serrata.* Port Renfrew, Butler & Polley, Tilden. Some specimens from this station approach *P. hypnoides.*

ANTITHAMNION FLOCCOSUM (Müll.) Kleen, forma PACIFICUM (Harv.) Setchell & Gardner, 1903, p. 341; P. B.-A., No. 147. Esquimalt, Harvey, as *Callithamnion floccosum* var. *pacificum;* Departure bay, Victoria, Macoun; Port Renfrew, Butler & Polley.

A. PYLAISÆI (Mont.) Kjellman. Setchell & Gardner, 1903, p. 342; Harvey, 1853, p. 239; P. B.-A., No. 97. Esquimalt, Harvey, fide specimen in Herb. Harvey marked *Callithamnion americanum.*

A. SUBULATUM (Harv.) J. G. Agardh. Setchell & Gardner, 1903, p. 342; P. B.-A., No. 944. Esquimalt, Harvey, as *Callithamnion subulatum;* Port Renfrew, Butler & Polley;

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[1] A small species of *Callithamnion* occurs partly endophytic in fronds of *Callymenia phyllophora;* see Leavitt, 1904. Fruit has not been observed, the fronds seem immature; it may be a young state of some known species, or may be new.

Vancouver island, Lichtenthaler. Since the publication of Setchell & Gardner, 1903, the type of this species has been found in Herb. Harvey; it agrees with P. B.-A., No. 944.

PLATYHAMNION HETEROMORPHUM J. G. Agardh, forma TYPICUM Setchell & Gardner, 1903, p. 344; P. B.-A., No. 343. Departure bay, on Gelidium dredged in 30–40 metres, Macoun.

CERAMIUM RUBRUM (Huds.) Agardh. Setchell & Gardner, 1903, p. 345. Harvey, 1853, p. 213; P. B.-A., Nos. 345, 646. Esquimalt, Harvey; Port Renfrew, Butler & Polley. The plant from Port Renfrew agrees very well with what passes for typical *C. rubrum* in the Atlantic.

Forma RADIANS, Petersen, 1908, p. 82, Pl. VI, fig. 3. Departure bay, on *Agardhiella*, Macoun. A very delicate form.

Var. **pacificum** Collins. Setchell & Gardner, 1903, p. 345; P. B.-A., Nos. 893, 1747. Departure bay, Barclay sound, Macoun; Port Renfrew, Butler & Polley. This name was first used with a plant distributed in Hauck & Richter, Phycotheca Universalis, No. 302. It has been in use since then, but as *nomen nudum*; It may be described as follows:—

Ramificatione regulariter dichotoma, dichotomiis inferne distantibus, superne magis approximatis, omnibus apertis; ramis mox incurvis, deinde parallelis, æquilongis, circumscriptione frondis flabellata; fronde ubique ramulis adventivis, crebris, brevibus, simplicibus furcatisve, obsita, sæpa ad segmentum singulum, alternatis vel sæpius series breves secundatas formantibus, longitudine 5 mm. raro superantibus, interdum in ramos majores exeuntibus; corticatione continua ubique, cellularum minutarum series subdistinctas longitudinales formantium; cystocarpiis ad dichotomias ramulorum, et ad dichotomias 2 vel 3 ultimas frondis formatis, involucris bene evolutis circumdatis; tetrasporis sine ordine in cortice immersis.

Branching regularly dichotomous, forkings distant below, closer above, all wide, the branches soon incurved, becoming parallel, of even length, outline of frond flabellate; frond beset throughout with numerous short adventive branches, simple or forked, often on every segment, seldom exceeding 5 mm. in length, sometimes developing into branches of some size; cortication continuous throughout, of minute cells forming subdistinct longitudinal series; cystocarps formed at the forkings of the ramuli, and at the 2 or 3 last forkings of the frond, surrounded by well developed involucres; tetraspores immersed in the cortication, in no definite order.

This seems to be the common form of *C. rubrum* of the Pacific coast of America, from Alaska to southern California; it may be that among the numerous forms of corticated *Ceramium* of European waters to which names have been given some one may be found like this, but none is known to the writer; it has not been observed on the Atlantic coast of North America. The lateral branching is less developed than in most forms of the species, sometimes being represented only by the very abundant short adventive ramuli, all other branching being dichotomous. The forking is perfectly regular, distant at first, more and more frequent above, dense near the margin. The fronds are of moderate size at the base, uniformly diminishing, being very fine in the last forkings; as the two parts of each forking develop equally, the frond has an even rounded outline.[1]

C. TENUISSIMUM (Lyngb.) J. G. Agardh. Setchell & Gardner, 1903, p. 346; Harvey, 1853, p. 216; P. B.-A., No. 1298. Esquimalt, Harvey; Vancouver island, Lichtenthaler.

C. STRICTUM Harvey. P. B.-A., Nos. 347, 846. Departure bay, Macoun.

C. CALIFORNICUM J. G. Agardh. Setchell & Gardner, 1903, p. 346; P. B.-A., No. 447. Esquimalt, Harvey, as *C. diaphanum*.

C. CODICOLA J. G. Agardh. Setchell & Gardner, 1903, p. 346; P. B.-A. No. 248. Amphitrite point, on *Codium*, Macoun.

MICROCLADIA BOREALIS Ruprecht. Setchell & Gardner, 1903, p. 346; Harvey, 1853, p. 210; P. B.-A., No. 48. Fuca strait, Harvey; Port Renfrew, Butler & Polley; Esquimalt, Port Holmes, Sooke, Macoun.

M. COULTERI Harvey, 1853, p. 209; Setchell & Gardner, 1903, p. 347; P. B.-A., No. 1489. Port Renfrew, Butler & Polley; Esquimalt, Harvey; Comox, Victoria, Macoun.

M. CALIFORNICA Farlow. Setchell & Gardner, 1903, p. 347; P. B.-A., No. 548. Port Renfrew, Butler & Polley. *M. borealis* and *M. coulteri* appear to be abundant here, but *M. californica* rare, and at its northern limit.

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[1] The report of *C. cancellatum* at Esquimalt, Harvey, has not been confirmed.

RHODOCHORTON ROTHII (Turton) Nâgeli. Setchell & Gardner, 1903, p. 347; Harvey, 1853, p. 242, as *Callithamnion rothii;* P. B.-A., No. 49. Victoria, Gardner.

GLOIOPELTIS FURCATA (Post. & Rupr.) J. G. Agardh. Setchell & Gardner, 1903, p. 348; Harvey, 1853, p. 183; P. B.-A., No. 945. Port Renfrew, Butler & Polley.

GLOIOSIPHONIA CAPILLARIS (Huds.) Carmichael. Harvey, 1853, p. 202; P. B.-A., Nos. 849, 1700. Departure bay, Amphitrite point, Comox, Macoun; Esquimalt, Harvey. The plants collected by Macoun from these stations agree with each other and with the Atlantic plant; this confirms Harvey's record, which was heretofore the only one for the Pacific. *G. californica* (Farl.) J. G. Agardh, common from Washington to southern California, has not been reported from Vancouver island.

G. VERTICILLARIS Farlow. Setchell & Gardner, 1903, p. 348; P. B.-A., No. 100; Tilden, Centuries, No. 205. Port Renfrew, Tilden. To this species should probably be referred *Halymenia ligulata*, from Esquimalt, of Harvey's Lyall paper.

AEODES NITIDISSIMA J. G. Agardh. Setchell & Gardner, 1903, p. 349 ; P. B.-A., No. 946. (121). Amphitrite point, Ucluelet. Macoun, a single specimen only.

GRATELOUPIA CUTLERIÆ (Binder) J. G. Agardh. Setchell & Gardner, 1903, p. 349; P. B.-A., No. XCIX; Tilden, Centuries, No. 304. Victoria, Comox, Macoun; Esquimalt, Tilden.

G. PINNATA (Post. & Rupr.) Setchell in P. B.-A., No. 947; Setchell & Gardner, 1903, p. 349. Port Renfrew, Butler & Polley.

PRIONITIS LANCEOLATA Harvey, 1853, p. 197; Setchell & Gardner, 1903, p. 352; P. B.-A., No. 199. This species passes insensibly into the following, and most of the material from Vancouver island called *P. lanceolata* belongs under the narrow pinnate form of *P. lyallii.* A few specimens, from Victoria, Macoun, agree with *P. lanceolata* of more southern regions.

P. LYALLII Harvey, 1862, p. 173; Setchell & Gardner, 1903, p. 350. An extremely variable plant, as may be seen by the numerous forms recorded by Harvey and by Setchell & Gardner. What appears to be the typical form,

Forma NORMALIS Setchell & Gardner, 1903, p. 350, was collected at Victoria, Departure bay, Macoun.

Forma ORNATA Harvey. Setchell & Gardner, 1903, p. 351; P. B.-A., No. 949. Esquimalt, Harvey, Gardner; Port Renfrew, Butler & Polley; Victoria, Departure bay, Ucluelet, Macoun.

Forma DENSISSIMA Harvey. Setchell & Gardner, 1903, p. 351; P. B.-A., No. 948. Esquimalt, Harvey, Gardner; Port Renfrew, Butler & Polley; Departure bay, Macoun.

Forma GLADIATA Setchell & Gardner, 1903, p. 351; P. B.-A., No. XXV. Port Renfrew, Butler & Polley.

The following forms from Harvey, 1862, could probably be picked out from any considerable collection, so variable are the plants, even from one locality.

Forma LANCEOLATA.
Forma INTERMEDIA.
Forma DILATATA.
Forma DEPAUPERATA.

CRYPTONEMIA OBOVATA J. G. Agardh. Setchell & Gardner, 1903, p. 352; P. B.-A., No. 550.

Amphitrite point, Ucluelet (208) Macoun.

CRYPTOSIPHONIA WOODII J. G. Agardh. Setchell & Gardner, 1903, p. 353; P. B.-A., Nos. 449, 1049. Victoria, J. G. Agardh; Port Holmes, Macoun. The tetraspores in this plant vary much in the manner of division. Agardh describes them as cruciate, but with the reservation "*ni fallor*"; in the Port Holmes material they seem to be nearer to zonate. *C. woodii* and *C. grayana* cannot be maintained as distinct species, and the name *C. woodii* has the priority of position.

PIKEA CALIFORNICA Harvey, 1853, p. 246; P. B.-A., No. 897. Ucluelet, Macoun; Port Renfrew, Butler & Polley.

FARLOWIA MOLLIS (Harv. & Bail.) Farlow & Setchell in Setchell & Gardner, 1903, p. 354; Harvey, 1853, p. 175, as *Gigartina mollis;* P. B.-A., Nos. 898, 1150. Fuca strait, Esquimalt, Harvey; Port Renfrew, Butler & Polley; Departure bay, Port Holmes, Macoun. Some forms approach quite closely to *F. compressa* J. G. Agardh.

SARCOPHYLLIS CALIFORNICA J. G. Agardh. Setchell & Gardner, 1903, p. 354; P. B.-A., No. 395. Port Renfrew, Butler & Polley.

S. PYGMÆA Setchell. Setchell & Gardner, 1903, p. 355; P. B.-A., No. 396. Port Renfrew, Butler & Polley.[1]

CONSTANTINEA SUBULIFERA Setchell, 1906, p. 11; Setchell & Gardner, p. 356; P.B.-A., No. 950; Tilden, Centuries, No. 203; all as *C. sitchenis*. Esquimalt, Victoria, Tilden; Departure bay, Quatrains, Macoun.

LITHOTHAMNION CALIFORNICUM Foslie. Port Renfrew, Yendo.[2]

L. RECLINATUM Foslie. Port Renfrew, Yendo, as *L. conchatum*.

L. MEDIOCRE Foslie & Nichols. Setchell & Gardner, 1903, p. 359, as *Melobesia zostericolum* forma *mediocris;* P. B.-A., No. 299, as *M. amplexifrons.* On *Phyllospadix*, Port Renfrew, Yendo.

L. MARGINATUM Setchell & Foslie. Setchell & Gardner, 1903, p. 359, as *Melobesia marginata.* On *Laurencia pinnatifida,* Departure bay, Macoun.

LITHOPHYLLUM MURICATUM Foslie. Port Renfrew, Yendo.

L. INCRUSTANS forma ORBICULARE Foslie. Port Renfrew, Yendo.

L. VANCOUVERIENSE Foslie. Port Renfrew, Yendo.

AMPHIROA CRETACEA (Post. & Rupr.) Areschoug. Port Renfrew, Yendo.

A. TUBERCULOSA (Post. & Rupr.) Endlicher, forma TYPICA Setchell & Gardner, 1903, p. 361. Port Renfrew, Butler & Polley, Yendo.

Forma CALIFORNICA (Decaisne) Setchell & Gardner, 1903, p. 361. Fuca strait, Harvey, as *A. californica.* Port Renfrew, Yendo, as *Cheilosporum californicum.*

Forma FRONDESCENS (Post. & Rupr.) Setchell & Gardner, 1903, p. 362. Port Renfrew, Yendo, as *Cheilosporum frondescens.*

Forma PLANIUSCULA (Kütz.) Setchell & Gardner, 1903, p.

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[1] *Schizymenia californica* Harvey is founded on Lyall's specimen from Esquimalt. A plant agreeing with the description was collected at Amphitrite point (122) by Macoun. It is a question whether it is a good species, or should be placed under something else. More study is needed.

[2] The late Dr. M. Foslie made a special study of the crustaceous corallines, and described a very large number of species; the descriptions are contained in nearly 40 short papers; names of genera and species have been changed repeatedly in these papers; the general work in which he hoped to embody the results has not appeared; there can be given here only a list of the latest names used by him for algæ from Vancouver island.

363. Tilden, Centuries, No. 503, as *Cheilosporum planiusculum*. Port Renfrew, Yendo.[1]

CORALLINA OFFICINALIS L. forma CHILENSIS (Decaisne) Kützing. Port Renfrew, Yendo.

Forma ROBUSTA Setchell & Gardner, 1903, p. 365. Port Renfrew, Yendo, as *Cheilosporum macmillani*.

Forma MULTIRAMOSA Setchell & Gardner, 1903, p. 366. Port Renfrew, Yendo, as *C. vancouverensis*.

Forma ACULEATA (Yendo) Setchell & Gardner, 1903, p. 367. Port Renfrew, Tilden, as *C. aculeata*.

Var. SPATHULIFERA (Kütz.) Ardissone. P. B.-A., No. 350. Macoun.

The following table of geographical distribution indicates what species of Phæophyceæ and Rhodophyceæ (excluding Corallinaceae) of Vancouver island occur also in the following regions:—

(1.) The North American Pacific coast north of Vancouver island.

(2.) The North American coast south of Vancouver island.

(3.) The Asiatic Pacific coast.

(4.) The North American Atlantic coast.

(5.) The European Atlantic coast.

The number of Vancouver species so occurring, and their per cent of the total Vancouver species are as follows:—

——	Number.			Per cent.		
	Brown.	Red.	Total.	Brown.	Red.	Total.
Vancouver island.............	45	114	159			
1st Region....................	29	48	77	64	42	48
2nd "	29	84	113	64	74	71
3rd "	19	29	48	42	25	30
4th "	17	29	46	38	25	29
5th "	18	39	57	40	34	36

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[1] *A. epiphlegnoides*, Fuca strait, Harvey, must remain doubtful.

Only relative value can be placed on these proportions, as allowances must be made for two considerations. (1) The regions with which we are making comparison are not all equally well known; if the Asiatic flora were as well known as that of Europe, its proportion in the above list would undoubtedly be larger. (2) In comparing this region with two other regions, one of which has a flora considerably richer than the other, the former would naturally show the larger percentage. If, however, it were a question as to which of the other floras had a larger percentage of its species among those of the Vancouver region, the result might be the opposite.

The general conclusions are something as follows: the Vancouver flora has more species in common with the region south of it than with the region north of it; this is to be expected, as the number of species generally grows smaller as we go from subtropical through temperate to Arctic regions. As regards brown algæ, however, the number of species common to region 1 is the same as that common to region 2, which indicates a closer relation to the former; as regards the red algæ, the reverse seems to be true. The per cent common to the American coast of the north Atlantic is less than that common to the European coast, and this holds good as to both brown and red species. It may be partly due to the European flora being richer, but that is probably not all; some quite important species and genera appear to be common to the east sides of the two oceans, and missing on their western sides.

GEOGRAPHICAL DISTRIBUTION.

Phæophyceæ.	1	2	3	4	5
Pylaiella littoralis	+	+	+	+	+
Ectocarpus siliculosus	+	+	+	+	+
“ confervoides	+	+		+	+
“ mucronatus		+			
“ granulosus		+		+	+
Sphacelaria fusca		+	+	+	+
Coilodesme californica		+			
Colpomenia sinuosa	+	+	+	+	+
Scytosiphon lomentarius	+	+	+	+	+
Phyllitis fascia	+	+	+	+	+

GEOGRAPHICAL DISTRIBUTION.—*Continued.*

Phæophyceæ—*Con.*	1	2	3	4	5
Soranthera ulvoidea	+	+			
Desmarestia aculeata	+	+		+	+
" ligulata	+	+	+		+
Dictyosiphon fœniculaceus	+		+	+	+
Myrionema strangulans	+	+		+	+
Leathesia difformis	+	+	+	+	+
Mesogloia andersonii		+			
" simplex	+				
Chordaria abietina	+	+	+		
Carpomitra cabreræ			+		+
Ralfsia deusta	+		+	+	
Chorda filum	+		+	+	+
Laminaria andersonii		+			
" bullata	+				
" saccharina	+			+	+
" ephemera		+			
Hedophyllum sessile	+				
Cymathere triplicata	+				
Pleurophycus gardneri	+				
Costaria turneri	+	+	+		
Agarum fimbriatum					
Dictyoneuron californicum			+		
Lessoniopsis littoralis			+		
Postelsia palmæformis		+			
Macrocystis pyrifera	+	+			
Nereocystis luetkeana	+	+			
Egregia menziesii		+			
Pterygophora californica		+			
Alaria marginata	+				
" grandifolia	+				
" tenuifolia	+	+			
Fucus evanescens	+	+	+	+	+
" inflatus		+	+	+	+
Pelvetiopsis limitata		+			
Cystophyllum geminatum	+		+		

GEOGRAPHICAL DISTRIBUTION.—*Continued.*

Rhodophyceae.	1	2	3	4	5
Bangia fuscopurpurea..........	+	+		+	+
Porphyra umbilicalis..........	+			+	+
“ perforata..........	+	+			
“ nereocystis..........	+	+			
“ naiadum..........		+			
“ abyssicola..........					+
“ amplissima..........	+			+	+
“ miniata..........	+			+	+
“ variegata..........	+	+			
Erythrotrichia ceramicola......	+	+		+	+
Chantransia moniliformis......					+
“ hallandica........					+
“ macounii.					
Scinaia furcellata.............		+	+	+	+
Gelidium amansii		+	+		
“ crinale...............		+	+	+	+
Endocladia muricata..........	+	+			
Chondrus affinis..............		+	+		
“ crispus.............	+		+	+	+
Gymnogongrus norvegicus......				+	+
Iridæa laminarioides	+	+			
Gigartina mamillosa...........	+	+	+	+	+
“ exasperata..........		+			
Erythrophyllum delesserioides..		+			
Ahnfeldtia plicata............	+	+	+	+	+
“ concinna..........		+			
Sterrocolax crassior...........	+	+			
Callophyllis furcata...........		+			
“ flabellulata........		+			
“ variegata.........	+	+			
Callymenia phyllophora........	+	+			
“ ornata............	+		+		
“ reniformis..........		+		+	+
Agardhiella tenera............		+		+	
Turnerella mertensiana........	+		+		
Anatheca furcata.............					

GEOGRAPHICAL DISTRIBUTION.—*Continued.*

Rhodophyceae—*Con.*	1	2	3	4	5
Euthora fruticulosa	+		+		
Gracilaria confervoides		+	+	+	+
Fauchea lacinata		+			
Chrysymenia pseudodichotoma		+			
Lomentaria ovalis		+			+
Plocamium coccineum		+	+		+
“ violaceum		+			
Rhodymenia palmata	+	+		+	+
“ palmetta				+	+
“ corallina		+			
“ flabellifolia		+			
“ pertusa	+		+		
Halosaccion glandiforme	+	+	+		
Nitophyllum ruprechtianum	+	+			
“ latissinum		+			
“ violaceum		+			
“ spectabile		+			
Schizoneura quercifolia		+			
Erythroglossum woodii					
Apoglossum decipiens	+	+			
Pteridium serratum	+		+		
“ alatum	+	+	+	+	+
Bonnemaisomia hamifera		+	+		+
Polysiphonia urceolata	+	+		+	+
“ tenuistriata		+			
“ nigrescens				+	+
“ subulata		+		+	+
Laurencia pinnatifida	+	+	+		+
Janczewskia verrucæformis		+			+
Pterosiphonia plumula		+			
“ bipinnata	+	+	+		
“ parasitica		+			+
“ woodii		+			
Lophosiphonia villum	+	+			
“ obscura		+		+	+
Rhodomela lycopodioides	+		+	+	+

GEOGRAPHICAL DISTRIBUTION.—*Continued.*

Rhodophyceae—*Con.*	1	2	3	4	5
Rhodomela larix	+	+	+		
Odonthalia floccosa	+	+	+		
" lyallii	+	+			
" kamtschatica	+		+		
" aleutica	+				
" semicostata		+			
Dasyopsis plumosa		+	+		
Griffithsia schousbœi		+			+
Pleonosporium vancouverianum					
Callithamnion polyspermum					+
Ceratothamnion pikeanum	+	+			
Ptilota filicina	+	+			
" hypnoides		+			
" californica		+	+		
Antithamnion floccosum	+	+		+	+
" pylaisæi				+	+
" subulatum					
Platythamnion heteromorphum		+			
Ceramium rubrum	+	+	+	+	+
" tenuissimum		+	+	+	+
" strictum				+	+
" californicum		+			
" codicola	+	+			
Microcladia borealis	+	+	+		
" coulteri		+			
" californica		+			
Rhodochorton rothii	+	+		+	+
Gloiopeltis furcata	+		+		
Gloiosiphonia capillaris			+	+	+
" verticillaris		+			
Aeodes nitidissima		+			
Grateloupia cutleriæ		+			
" pinnata	+				
Prionitis lanceolata		+			
" lyallii		+			
Cryptonemia obovata		+			

GEOGRAPHICAL DISTRIBUTION—*Concluded*

Rhodophyceae—*Con.*	1	2	3	4
Cryptosiphonia woodii	+	+		
Pikea californica		+		
Farlowia mollis		+		
Sarcophyllis californica	+	+		
" pygmæa		+		
Constantinea subulifera	+			

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Canada
Geological Survey
Victoria Memorial Museum
BULLETIN No. 1

XVI.—*Hydroids from Nova Scotia.*

By C. McLean Fraser.

The material for this report was collected in distant localities, at times some distance apart. Much of it was collected by the writer in the neighbourhood of Canso, the extreme eastern point of the mainland, in the summer of 1902, when the Marine Biological Laboratory was located temporarily at that place; the remainder was collected by Mr. John Macoun, in the neighbourhood of Barrington Passage at the extreme southern end of the peninsula, in the summer of 1910.

At Canso, the numerous old wharves and piles afford good collecting ground within the harbour. There are numerous islands in the vicinity, but as their shore line consists usually of hard smooth granite, comparatively few species are to be found. In Chedabucto bay, by dredging in from 20 to 50 fathoms of water many fine specimens were found, but the bottom is so rough and rocky that dredging is rather a slow process, and conditions are very similar near by in the open Atlantic. A good opportunity was afforded for getting some fine specimens from the Codbanks. Cod fishing was carried on in about 45 to 50 fathoms with the trawl lines. Very often the trawl hooks brought stalked ascidians or pieces of rock to which were attached specimens of hydroids. Taking everything into consideration, therefore, the conditions gave variety enough to obtain some interesting specimens.

At Barrington Passage, the specimens were obtained from shallow water to a depth of 5 fathoms.

Of the 50 species reported, two are new, viz., *Campanularia magnifica* and *Cryptolaria triserialis*. Three others, *Campanularia grœnlandica*, *Lafœa symmetrica*, and *Halecium minutum* have not previously been reported from the east coast of North America.

My thanks are due to Professor Nutting for his assistance in this as well as other hydroid work I have done, and to my wife who has made the drawings.

SYSTEMATIC DISCUSSION.

No family or genus has been defined in this paper because, with the exception of the Genus *Cryptolaria*, they have been defined in my West Coast paper, and are here used with the same significance. With regard to the genus mentioned, there has been no disagreement among the authors who have used it. In the synonymy I have given the original reference for the species in each case, and besides this, when possible, some references to papers dealing with localities not very far distant. It is for that reason that Prof. Nutting's paper on the Woods Hole region appears so often, and also that of J. F. Whiteaves, although the latter gives no definitions and little synonymy.

Full descriptions of several of the species appear in two of my own papers that are still in manuscript, viz: "Some Beaufort Hydroids," being published by the U. S. Bureau of Fisheries, and "Some notes on New England Hydroids" being published in a Bulletin from the Laboratories of Natural History of the State University of Iowa.

CLAVIDÆ.

Genus CLAVA.

CLAVA LEPTOSTYLA Agassiz.

Clava leptostyla Agassiz, Cont. Nat. Hist. U. S., Vol. IV, 1862, p. 218.

Clava leptostyla Verrill, Invert. An. of Vineyard sound, 1874, p. 328.

Clava leptostyla Nutting, Hydroids of Woods Hole, 1901, p. 321.

Clava leptostyla Whiteaves, Marine Invertebrates of Eastern Canada, 1901, p. 18.

On piles of the wharves and on stones, at or near low water, not very abundant. Canso.

BOUGAINVILLIDÆ.

Genus BOUGAINVILLIA.

BOUGAINVILLIA CAROLINENSIS (McCrady).

Hippocrene carolinensis McCrady, Gymn. of Charleston har., 1857, p. 62.

Margelis carolinensis Agassiz, Cont. Nat. Hist. U. S., Vol. IV, 1862, p. 344.

Margelis carolinensis Verrill, Invert. An. of Vineyard sound, 1874, p. 733.

Bougainvillia carolinensis Nutting, Hydroids of Woods Hole, 1901, p. 330.

On rocks at low water, Grassy island, Canso. Not previously reported from Nova Scotia.

EUDENDRIDÆ.

Genus EUDENDRIUM.

EUDENDRIUM DISPAR Agassiz.

Eudendrium dispar Agassiz, Cont. Nat. Hist. U. S., Vol. IV, 1862, p. 285.

Eudendrium dispar Nutting, Hydroids of Woods Hole, 1901, p. 332.

Eudendrium dispar Whiteaves, Marine Invert. of Eastern Canada, 1901, p. 20.

Collected by Mr. John Macoun, in 5 fathoms, Barrington Passage.

EUDENDRIUM RAMOSUM (Linnæus).

Tubularia ramosa Linnæus, Systema Naturæ, 1758, p. 804.

Eudendrium ramosum Hincks, British Hydroid Zoophytes, 1868, p. 82.

Eudendrium ramosum Nutting, Hydroids of Woods Hole, 1901, p. 332.

Eudendrium ramosum Whiteaves, Marine Invert. of Eastern Canada, 1901, p. 19.

One specimen on a Buccinum shell, dredged in 45 fathoms, Chedabucto bay, Canso.

EUDENDRIUM TENUE A. Agassiz.

Eudendrium tenue A. Agassiz, North American Acalephæ, 1865, p. 160.

Eudendrium tenue Nutting, Hydroids of Woods Hole, 1901, p. 333.

Eudendrium tenue Whiteaves, Marine Invert. Eastern Can., 1901, p. 20.

Plentiful on mussel shells, near low water in the harbour, Canso.

HYDRACTINIDÆ.

Genus HYDRACTINIA.

HYDRACTINIA ECHINATA (Fleming).

Alcyonium echinatum Fleming, British Animals, 1828, p. 517.

Hydractinia echinata Hincks, British Hydroid Zoophytes, 1868, p. 23.

Hydractinia polyclina Agassiz, Cont. Nat. Hist. U. S., Vol. IV, 1862, p. 227.

Hydractinia polyclina Nutting, Hydroids of Woods Hole, 1901, p. 335.

Hydractinia echinata Whiteaves, Marine Invert. Eastern Can., 1901, p. 21.

Common on Littorina shells inhabited by hermit crabs and on small stones, at low water in the harbour, Canso.

CORYMORPHIDÆ.

Genus CORYMORPHA.

CORYMORPHA PENDULA Agassiz.

Corymorpha pendula Agassiz, Cont. Nat. Hist. U. S., Vol. IV, 1862, p. 227.

Corymorpha pendula Nutting, Hydroids of Woods Hole, 1901, p. 337.

Monocaulis glacialis Whiteaves, Marine Invert. Eastern Can., 1901, p. 21.

Two specimens dredged from muddy bottom at a depth of 50 fathoms, in the Atlantic at the entrance to Chedabucto bay, Canso.

TUBULARIDÆ.

Genus TUBULARIA.

TUBULARIA CROCEA (Agassiz).

Parypha crocea Agassiz, Cont. Nat. Hist. U. S., Vol. IV, 1862, p. 249.

Parypha crocea Verrill, Invert. An. Vineyard sound, 1874, p. 390.

Tubularia crocea Nutting. Hydroids of Woods Hole, 1901, p. 340.

Plentiful on mussel shells attached to piles and on rocks in shallow water, in the harbour, Canso.

TUBULARIA LARYNX Ellis and Solander.

Tubularia larynx E. and S., Nat. Hist. of Zoophytes, 1786, p. 31.

Tubularia larynx Nutting, Hydroids of Woods Hole, 1901, p. 338.

Tubularia larynx Whiteaves, Marine Invert. Eastern Can., 1901, p. 20.

Collected at a depth of 4 fathoms, by Mr. John Macoun, Barrington Passage.

TUBULARIA TENELLA (Agassiz).

Thamnocnidia tenella Agassiz, Cont. Nat. Hist. U. S., 1862, p. 275.

Tubularia tenella Nutting, Hydroids of Woods Hole, 1901, p. 339.

Tubularia tenella Whiteaves, Marine Invert. Eastern Can., 1901, p. 20.

On mussel shells below low water mark, on exposed shores, Canso.

CAMPANULARIDÆ.

Genus CAMPANULARIA.

CAMPANULARIA AMPHORA (Agassiz).

Laomedea amphora Agassiz, Cont. Nat. Hist. U.S., IV, 1862, p. 311.

Campanularia amphora Nutting, Hydroids of Woods Hole, 1901, p. 347.

On mussel shells under Hart's wharf, and on rocky coast, Canso.

CAMPANULARIA FLEXUOSA (Hincks).

Laomedea flexuosa Hincks, Ann. and Mag. Nat. Hist., 3rd ser. VIII, 1861, p. 260.

Campanularia flexuosa Hincks, British Hydroid Zoophytes, 1868, p. 168.

Campanularia flexuosa Nutting, Hydroids of Woods Hole, 1901, p. 348.

Campanularia flexuosa Whiteaves, Marine Invert. Eastern Can., 1901, p. 22.

One of the most abundant hydroids on the coast, found growing everywhere at or near low water, on rocks, seaweeds, etc.

CAMPANULARIA GRŒNLANDICA Levinsen.

Campanularia grœnlandica Levinsen, Meduser, Ctenophorer og Hydroider fra Grœnlands Vestkyst, 1893, p. 26.

Several specimens of this fine species were found growing on *Sertularella tricuspidata* attached to the stalk of an ascidian, brought up by a trawl hook from a depth of 50 fathoms on the Canso Banks in the Atlantic, 7 or 8 miles east of Canso. This species has not been reported previously from the east coast of North America, south of Greenland.

CAMPANULARIA MAGNIFICA new species.

Plate XI, figs. 1-3.

Trophosome. Colonies consisting of solitary individuals growing from a stout stolon which is not annulated but may be slightly sinuous. The hydrothecæ are very large, as much as 2·5mm. in length and with greatest width about 0·8mm. They are nearly tubular with a tendency to be slightly urceolate. The margin is slightly flaring, is crenulated with 10 or 12 elevations and depressions. A series of parallel lines pass down vertically from the margin for about one-third the length of the hydrotheca. The pedicels vary much in length but never exceed twice the length of the hydrotheca. They are annulated throughout.

Gonosome. The gonangia are very large also. The male and female are similar in size and shape, somewhat longer than the hydrothecæ and also broader at the greatest diameter. The gonangium is supported on a very short pedicel, is almost oval in shape except that the distal end is drawn out into a long bottle-neck. The aperture is circular, occupying the whole of the distal end. A few corrugations, low and not very noticeable, are present on the broad proximal portion.

Distribution. Several specimens, in close company with *Halecium tenellum,* attached to a stalked ascidian, were brought up by a trawl hook from a depth of 50 fathoms on the Canso Banks.

The trophosome of this species bears a great resemblance to that of *Campanularia speciosa* Clark[1]. Prof. Nutting had some of Clark's original specimens from Shumagin islands, Alaska, and by using those I was able to make a comparison of the two. The hydrotheca is more urceolate in *C. speciosa* than in *C. magnifica* and the stolon is distinctly annulated, but in other respects they are very similar; when the gonosome is present there is no difficulty as the obconical gonangium of *C. speciosa* bears little resemblance to the elongated gonangium of *C. magnifica.* I have made a drawing of *C. speciosa* from a Shumagin Island specimen, showing the hydrotheca and the gonangium to the same scale so that the two species may be compared (See Plate XI, fig. 4).

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[1] Clark, S. F. Alaskan Hydroids, 1876, p. 24.

CAMPANULARIA NEGLECTA (Alder).

Laomedea neglecta Alder, Cat. Zooph. Northumberland and Durham, 1857, p. 33.

Campanularia neglecta Nutting, Hydroids of Woods Hole, 1901, p. 346.

Growing on *Obelia commissuralis* under the wharves, Canso.

CAMPANULARIA VERTICILLATA (Linnæus).

Sertularia verticillata Linnæus, Systema Naturæ, 1758, p. 811.

Campanularia verticillata Nutting, Hydroids of Woods Hole, 1901, p. 347.

Campanularia verticillata Whiteaves, Marine Invert. Eastern Can., 1901, p. 22.

On rocks brought from a depth of 50 fathoms, east in the Atlantic and in Chedabucto bay, Canso.

CAMPANULARIA VOLUBILIS (Linnæus).

Sertularia volubilis Linnæus, Systema Naturæ, 1767, p. 1311.

Campanularia volubilis Verrill, Invert. An. Vineyard sound, 1874, p. 408.

Campanularia volubilis Nutting, Hydroids of Woods Hole, 1901, p. 345.

Campanularia volubilis Whiteaves, Marine Invert. Eastern Can., 1901, p. 22.

On bryozoan, collected by Mr. John Macoun in 5 fathoms, Barrington Passage; on stalked ascidians and on *Sertularella tricuspidata* growing on these stalks, in 50 fathoms, Canso Banks.

Genus CLYTIA.

CLYTIA JOHNSTONI (Alder).

Campanularia johnstoni Alder, Cat. Zooph. Northumb. and Durham, 1857, p. 36.

Clytia bicophora Agassiz, Cont. Nat. Hist. U.S., IV, 1862, p. 304.

Clytia bicophora Nutting, Hydroids of Woods Hole, 1901, p. 343.

Clytia johnstoni Whiteaves, Marine Invert. Eastern Can., 1901, p. 24.

In shallow water, Barrington Passage; abundant on mussel shells and on *Obelia commissuralis* under wharves and elsewhere near low water in the harbour, Canso.

Genus EUCOPELLA.

EUCOPELLA CALICULATA (Hincks).

Campanularia caliculata Hincks, Ann. and Mag. Nat. Hist., 2nd ser. XI, 1853, p. 178.

Clytia poterium Agassiz, Cont. Nat. Hist. U.S., IV, 1862, p. 297.

Campanularia poterium Nutting, Hydroids of Woods Hole, 1901, p. 344.

Campanularia caliculata Whiteaves, Marine Invert. Eastern Can., 1901, p. 23.

Rather common on seaweed at about 20 fathoms, off the islands between Chedabucto bay and the Atlantic, Canso.

Genus GONOTHYRÆA.

GONOTHYRÆA GRACILIS (Sars).

Laomedea gracilis Sars, Beretning om en zoologisk Reise i Lofoten og Finmarken, 1851, p. 18.

Gonothyræa gracilis Allman, Ann. and Mag. Nat. Hist., 3rd ser. XIII, 1864, p. 374.

Gonothyræa gracilis Verrill, Proc. Am. Assn. Adv. Sc., 1874, p. 364.

On tangle of *Tubularia crocea*, in shallow water, Canso; in shallow water, Barrington Passage.

GONOTHYRÆA LOVENI (Allman).

Laomedea loveni Allman, Ann. and Mag. Nat. Hist., 3rd ser. IV, 1859, p. 138.

Gonothyræa loveni Allman, Ann. and Mag., 3rd ser. XIII, 1864, p. 374.

Gonothyræa loveni Nutting, Hydroids of Woods Hole, 1901, p. 352.

On red algæ in 20 fathoms, Chedabucto bay, Canso.

Genus OBELIA.

OBELIA COMMISSURALIS McCrady.

Obelia commissuralis McCrady, Gymno. Charleston har., 1858, p. 95.

Obelia commissuralis Nutting, Hydroids of Woods Hole, 1901, p. 350.

Obelia commissuralis Whiteaves, Marine Invert. Eastern Can., 1901, p. 23.

The commonest campanularian of the region; on rocks, piles, seaweeds, etc., at or below low water, Canso.

OBELIA DICHOTOMA (Linnæus).

Sertularia dichotoma Linnæus, Systema Naturæ, 1758, p. 812.

Obelia dichotoma Nutting, Hydroids of Woods Hole, 1901, p. 350.

Obelia dichotoma Whiteaves, Marine Invert. Eastern Can., 1901, p. 23.

Common on Laminaria, at and below water, Canso.

OBELIA GENICULATA (Linnæus).

Plate XII, figs. 1 and 2.

Sertularia geniculata Linnæus, Systema Naturæ, 1767, p. 1312.

Obelia geniculata Nutting, Hydroids of Woods Hole, 1901, p. 350.

Obelia geniculata Whiteaves, Marine Invert. Eastern Can., 1901, p. 23.

In 3 fathoms, Barrington Passage; on laminaria and other seaweeds, on piles, etc., at low water, Canso.

Some abnormal specimens of this species were found growing on *Lemargus margilis*—a copepod, parasitic on a sunfish (*Mola mola*), caught in Chedabucto bay. In normal specimens, the hydrothecæ appear in regular alternation to give the regular geniculate appearance of the stem. The gonophores appear in the axils, being regularly disposed but not in any way affecting the geniculation of the stem. In this case the gonophores take the place of the hydrothecæ, making up a portion of the regular geniculate arrangement, and do not appear in the axils.

CAMPANULINIDÆ.

Genus CALYCELLA.

CALYCELLA SYRINGA (Linnæus).

Sertularia syringa Linnæus, Systema Naturæ, 1767, p. 1311.

Calycella syringa Nutting, Hydroids of Woods Hole, 1901, p. 355.

Calycella syringa Whiteaves, Marine Invert. Eastern Can., 1901, p. 23.

In shallow water, Barrington Passage; abundant on *Sertularella tricuspidata* from 50 fathoms, Canso Banks.

Genus OPERCULARELLA.

OPERCULARELLA LACERATA (Johnston).

Campanularia lacerata Johnston, British Zoophy tes, 1847, p 111.

Opercularella lacerata Nutting, Hydroids of Woods Hole, 1901, p. 354.

On the rocks at low tide, Fox island, Chedabucto bay, Canso.

HALECIDÆ.

Genus HALECIUM.

HALECIUM BEANI (Johnston).

Thoa beani Johnston, British Zoophytes, 1847, p. 120.

Halecium beani Nutting, Hydroids of Woods Hole, 1901, p. 358.

In 5 fathoms, Barrington Passage; in 50 fathoms, Canso Banks.

HALECIUM MINUTUM BROCH.

Plate XII, figs. 3, 4.

Halecium minutum Broch, Nordmeer gesammelten Hydroiden, 1903, p. 4.

On ascidian stalks from 50 fathoms, on the Canso Banks.

Since Broch first described this species there has been no further report of it where the diagnosis was certain. Broch, himself, in his paper on Arctic Hydroids[1] mentions a species that he takes to be the same but he is not sure as he did not find the gonosome. Later Kramp[2] for the same reason could not be sure of the specimens he found. All of these specimens were found in the Arctic or Subarctic regions. There was not such trouble in the case of the specimens found at Canso as the gonophores were numerous. When they are present they are so large and conspicuous that they must be observed before the trophosome is. The trophosome bears so much resemblance to that of *H. tenellum* that they are hard to distinguish from each other. When the gonosome is present such a mistake could not be made as the gonangium of *H. minutum* may be as much as 3 mm. in long diameter and not far from that in short diameter. The thickness is not so great, so that altogether its shape somewhat resembles the shell of a bivalve. The arrangement of the teeth or spines around the margin at the distal end gives it a unique appearance among the gonangia of the Halecidæ. The gonangium of *H. muricatum* most nearly resembles it, but is not more than one-fourth of the size and it is spiny on the flat surfaces as well as on the margin; while that of *H. minutum* has but few spines on the margin and none on the flat surfaces.

The figures show the relatively small stem and the very large gonangium.

HALECIUM MURICATUM (Ellis and Solander).

Sertularia muricatum E. and S., Nat. Hist. Zooph., 1786, p. 59.

Halecium muricatum HINCKS, British Hydroid Zoophytes, 1868, p. 223.

Halecium muricatum WHITEAVES, Marine Invert. Eastern Can., 1901, p. 25.

On ascidian stalks from 50 fathoms on the Canso Banks. A few specimens, well supplied with gonangia, were collected.

HALECIUM TENELLUM Hincks.

Halecium tenellum HINCKS, Ann. and Mag. Nat. Hist., 3rd ser. VIII, 1861, p. 252.

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[1] Die Hydroiden der Arktischen Meere, 1909, p. 153

[2] Report on the Hydroids of the Denmark Expedition, 1911, p. 370.

Halecium tenellum NUTTING, Hydroids of Woods Hole, 1901, p. 357.

Common on ascidian stems in 50 fathoms of the Canso Banks.

LAFŒIDÆ.

Genus CRYPTOLARIA.

CRYPTOLARIA TRISERIALIS new species.

Plate XIII, figs. 1 and 2.

Trophosome. Stem fascicled, very coarse. No complete colony was obtained. The largest fragment was 4 cm. long and 0·8 mm. in diameter. There were several large branches given off from the main stem. On the stem the hydrothecæ are not numerous; they appear singly or in opposite or sub-opposite pairs, each with about the distal half free. On the branches, where they are free from fasciculation, the hydrothecæ are nearer together, arranged in three series, two making such a wide angle with each other that they are not far from being in the same plane, and the other intermediate between them on the larger side. The hydrothecæ of the first two series appear in pairs, those of the other alternate with these pairs. They are large, from 1·5 to 2 mm. in length and 0·35 mm. in diameter. The proximal half is in contact with the branch, the distal half curves regularly outward.

Gonosome. Unknown.

Distribution. Dredged in 20 fathoms off Durell island, Chedabucto bay, Canso.

In some respects this species resembles *Cryptolaria borealis* Levinsen[1]. His description is rather meagre, but as his colonies were only from 4·5 to 20 mm. long, the species must be a much smaller one than that herein described. On the non-fascicled branches, the hydrothecæ are arranged in four series, giving a cruciform arrangement, while in this species there are but three series. These differences alone seem sufficient to indicate that the Canso specimens are of a different species to those found in Davis strait.

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[1] Meduser, Ctenophorer og Hydroider fra Grœnlands Vestkyst, 1893, p. 31.

Genus FILELLUM.

FILELLUM EXPANSUM Levinsen.

Filellum expansum LEVINSEN, Hydroider fra Grœnlands Vestkyst, 1893, p. 30.

Common in shallow water, growing on other hydroids, Barrington Passage and Canso.

This species seems very common all the way down the coast as far as Beaufort, N.C. A description of the species containing an original description of the coppinia mass has been given in a paper, "Notes on New England Hydroids" mentioned in the introduction of this paper.

FILELLUM SERPENS (Hassall).

Campanularia serpens HASSALL, Trans. Micro. Soc., III, 1852, p. 163.

Reticularia serpens VERRILL, Checklist, 1879, p. 79.

On *Sertularella polyzonias* from 50 fathoms, Canso Banks.

Genus GRAMMARIA

GRAMMARIA ABIETINA (Sars).

Campanularia abietina SARS, Nyt Mag. for Naturvidensk, bd. 6, 1851, p. 139.

Grammaria robusta STIMPSON, Marine Invert. of Grand Manan, 1854, p. 9.

Grammaria abietina WHITEAVES, Marine Invert. Eastern Can., 1901, p. 28.

Dredged from rocky bottom in 20 fathoms, near the shore in Chedabucto bay, Canso.

Genus LAFŒA.

LAFŒA DUMOSA (Fleming).

Sertularia dumosa FLEMING, Edin. Phil. Jour., II., 1828, p. 83.

Lafœa dumosa NUTTING, Hydroids of Woods Hole, 1901, p. 355.

Lafœa dumosa WHITEAVES, Marine Invert. Eastern Can., 1901, p. 24.

Dredged from rocky bottom in 20 fathoms, Chedabucto bay, Canso.

LAFŒA FRUTICOSA Sars.

Lafœa fruticosa SARS, Norske Hydroider, 1862, p. 30.

Lafœa fruticosa VERRILL, Checklist, 1879, p. 17.

Dredged from rocky bottom in 20 fathoms, Chedabucto bay, Canso.

LAFŒA GRACILLIMA (Alder).

Campanularia gracillima ALDER, Trans. Tynes. Nat. Field Club, 1857, p. 39.

Lafœa gracillima NUTTING, Hydroids of Woods Hole, 1901, p. 356.

Lafœa gracillima WHITEAVES, Marine Invert. Eastern Can., 1901, p. 24.

On rock brought up by trawl hook from 50 fathoms, Canso Banks.

LAFŒA SYMMETRICA Bonnevie.

Lafœa symmetrica BONNEVIE, Den Norske Nordhavs Expedition, 1899, p. 64.

Lafœa symmetrica BILLARD, Exped. Sc. du "Travailleur" et du "Talisman," 1907, p. 176.

Dredged from rocky bottom in 20 fathoms, Chedabucto bay, Canso.

This species has been reported only from Norway by Bonnevie and from Cape Spartel by Billard. Jâderholm makes it synonymous with *Lafœa grandis*,[1] but I think there is not good basis for so doing. Specimens of *L. grandis* found in the Vancouver Island region have much larger hydrothecæ than these from Canso and apparently that is true of the specimens reported from Iceland by Hincks when he gave the original description of *L. grandis*.[2]

LAFŒA PYGMÆA (Alder).

Lafœa pygmæa HINCKS, British Hydroid Zoophytes, 1868, p. 205.

Hebella pygmæa NUTTING, Hydroids of Woods Hole, 1901, p. 353.

Lafœa pygmæa BROCH, Nordmeer gesammelten Hydroiden, 1903, p. 5.

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[1] Northern and Arctic Invertebrates, 1909, p. 72.

[2] Ann. and Mag. Nat. Hist., 4th ser. XIII, 1874, p. 148.

On a bryozoan (*Menipea ternata*) dredged in 25 fathoms in Chedabucto bay, Canso.

This species has been placed in the genus *Hebella* by some authors, but it has no hydrothecal diaphragm and hence cannot be placed there. Since Broch found and described the coppinia mass there is still better evidence that the species should be placed with *Lafœa* rather than with *Hebella* as the gonangia of *Hebella* are not massed.

SERTULARIDÆ.

Genus ABIETINARIA.

ABIETINARIA ABIETINA (Linnæus).

Sertularia abietina LINNÆUS, Systema Naturæ, 1758, p. 808.

Sertularella abietina NUTTING, Hydroids of Woods Hole, 1901, p. 361.

Sertularia abietina WHITEAVES, Marine Invert. Eastern Can., 1901, p. 25.

Abietinaria abietina NUTTING, American Hydroids, Part II, 1904, p. 114.

On rock from 50 fathoms, Canso Banks.

Genus DIPHASIA.

DIPHASIA FALLAX (Johnston).

Sertularia fallax JOHNSTON, British Zoophytes, 1847, p. 73.

Diphasia fallax NUTTING, Hydroids of Woods Hole, 1901, p. 361.

Diphasia fallax WHITEAVES, Marine Invert. Eastern Can., 1901, p. 26.

Diphasia fallax NUTTING, American Hydroids, Part II, 1904, p. 114.

Dredged in 4 fathoms, Barrington Passage.

DIPHASIA ROSACEA (Linnæus).

Sertularia rosacea LINNÆUS, Systema Naturæ, 1758, p. 807.

Diphasia rosacea NUTTING, Hydroids of Woods Hole, 1901, p. 361.

Diphasia rosacea WHITEAVES, Marine Invert. Eastern Can., 1901. p. 26.

Diphasia rosacea NUTTING, Amer. Hydroids, Part II, 1904, p. 107.

Very abundant in the material from Barrington Passage.

Genus HYDRALLMANIA

HYDRALLMANIA FALCATA (Linnæus).

Sertularia falcata LINNÆUS, Systema Naturæ, 1758, p. 810.

Hydrallmania falcata NUTTING, Hydroids of Woods Hole, 1901, p. 364.

Hydrallmania falcata WHITEAVES, Marine Invert. Eastern Can., 1901, p. 27.

Hydrallmania falcata NUTTING, Amer. Hydroids, Part II, 1904, p. 124.

Common in material from Barrington Passage.

Genus SELAGINOPSIS.

SELAGINOPSIS MIRABILIS (Verrill).

Diphasia mirabilis Verrill, Amer. Jour. Sci. and Arts, 1872, p. 9.

Diphasia mirabilis Whiteaves, Marine Invert. Eastern Can., 1901, p. 26.

Selaginopsis mirabilis Nutting, Amer. Hydroids, Part II, 1904, p. 128.

On rock from 50 fathoms, Canso Banks.

Genus SERTULARELLA.

SERTULARELLA CONICA Allman.

Sertularella conica Allman, Hydroids of the Gulf Stream, 1877, p. 21.

Sertularella conica Nutting, Amer. Hydroids, Part II, 1904, p. 79.

Sertularella conica Fraser, West Coast Hydroids, 1911, p. 68.

A few young colonies were found growing on *Sertularella tricuspidata* from an ascidian stalk in 50 fathoms on the Canso Banks.

SERTULARELLA POLYZONIAS (Linnæus).

Sertularella polyzonias Nutting, Amer. Hydroids, Part II, 1904, p. 90.

Sertularia polyzonias Linnæus, Systema Naturæ, 1758, p. 813.

Sertularella polyzonias Nutting, Hydroids of Woods Hole, 1901, p. 362.

Sertularella polyzonias Whiteaves, Marine Invert. Eastern Can., 1901, p. 25.

Dredged in rocky bottom in 10-20 fathoms, Chedabucto bay, Canso.

SERTULARELLA TRICUSPIDATA (Alder).

Sertularia tricuspidata Alder, Ann. and Mag. Nat. Hist., 2nd ser. XVIII, 1856, p. 356.

Sertularella tricuspidata Nutting, Hydroids of Woods Hole, 1901, p. 362.

Sertularella tricuspidata Whiteaves, Marine Invert. Eastern Can., 1901, p. 26.

Sertularella tricuspidata Nutting, Amer. Hydroids, Part II, 1904, p. 71.

Common on rocks and ascidian stems in 50 fathoms, Canso Banks.

Genus SERTULARIA.

SERTULARIA PUMILA Linnæus.

Sertularia pumila Linnæus, Systema Naturæ, 1758, p. 807.

Sertularia pumila Nutting, Hydroids of Woods Hole, 1901, p. 359.

Sertularia pumila Whiteaves, Marine Invert. Eastern Canada, 1901, p. 25.

Sertularia pumila Nutting, Amer. Hydroids, Part II, 1904, p. 51.

Very abundant everywhere, on piles, stones, seaweeds, etc., near the surface of the water, Canso.

Genus THUIARIA.

THUIARIA ARGENTEA (Linnæus).

Sertularia argentea Linnæus, Systema Naturæ, 1758, p. 809.

Thuiaria argentea Nutting, Hydroids of Woods Hole, 1901, p. 363.

Thuiaria argentea Whiteaves, Marine Invert. Eastern Can., 1901, p. 27.

Thuiaria argentea Nutting, Amer. Hydroids, Part II, 1904, p. 71.

Dredged in 5 fathoms, Barrington Passage; on rocks in 50 fathoms, Canso Banks.

THUIARIA LONCHITIS (Ellis and Solander).

Thuiaria lonchitis Nutting, Amer. Hydroids, Part II, 1904, p. 66.

Thuiaria lonchitis E. and S., Nat. Hist. Zoophytes, 1786, p. 42.

On rock from 50 fathoms, Canso Banks.

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Canada
Geological Survey
Victoria Memorial Museum
BULLETIN No. 1

XVII.—*The Archæology of Blandford Township, Oxford County, Ontario.*

By W. J. Wintemberg.

Location and Area.

Blandford township, Oxford county, Ontario, lies in the fertile farming country—about midway between Lakes Huron, Erie, and Ontario—in the cleared forest region, the St. Lawrence lowlands, and within the western part of the Iroquoian linguistic area, this region being occupied by the Neutral Indians, the westernmost tribe of the Iroquoian stock, when the early French missionaries arrived.

This township is bordered on the north by Wilmot township, Waterloo county; and on the east, south, and west by Blenheim, East Oxford, and East Zorra townships respectively, all of Oxford county. It is 12½ miles from north to south, and its greatest width is 8 miles.

Physical Features.

The topographical features are somewhat regular throughout the township, but a few high hills are encountered in the eastern lots of concession X. In the central portion of the township there is considerable light, sandy soil, and much of the land, especially that surrounding some of the lakes, is low and marshy. The land contiguous to Lockhart lake is of a hilly character, mainly composed of what is known locally as "blow" sand with very little humus. Here the principal timber was pine and other conifers. The country in the northern part of the township and between concessions I and III was once largely covered with deciduous trees.

Geologically the rock formation of this district belongs to the Corniferous period. Outcrops of limestone occur in the bed of the river Thames opposite Innerkip. However, very little of this limestone was utilized by the aboriginal inhabitants of the district, who used waterworn fragments occurring in the drift or local gravel beds.

The river Thames, bordered by high banks in several places, forms more than three-fourths of the western boundary of the township. Horner creek, having its source in East Zorra to the west, enters the township between concessions XI and XII. Numerous smaller streams traverse other parts. In the central portion there are several small lakes. One or two small dry lake beds occur in the eastern part of the township, and these no doubt were open lakes at no very remote period. Long, low-lying stretches of land between all the lakes and dry beds indicate that these were formerly connected by streams. Hagey lake is the only one surrounded, or partly surrounded by high banks.

ACKNOWLEDGMENTS.

Having studied the archæology of this township and partly completed a survey and map of the archæological features of the surface in continuance of the survey of Blenheim township which I made for the Provincial Museum in 1902,[1] and of my studies of other neighbouring townships, I was enabled to complete this surface survey by locating twenty-three habitation sites, four burial sites, and many surface finds in the autumn of 1912, as archæological field-worker of the Canadian Geological Survey. I wish to acknowledge my indebtedness especially to Messrs. John, Frederick, and Edwin Mitchell, James E. Hewitt, George A. Smith, and James Skillings.

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[1] Wintemberg, W. J., "Archæology of Blenheim Township," Ontario Archæological Report for 1902, pp. 58-70.

Lodge or House Sites.

The sites of prehistoric houses or lodges in this township are indicated by circular spots on the fields, made up of blackened soil. These spots are from about 10 to 20 feet, or more, in diameter. The usual fire-burnt and broken stones and blackened soil due to decayed organic matter, mixed with burned material, are always present in the sites. No artifacts are found in the lodge sites, but they are found in the unblackened soil surrounding them. The fire-burnt and cracked stones no doubt mark the floor of a fire-place. In lodge site No. 11 and several others no stones were found in the surrounding sandy soil; hence those found in the site must have been brought from a distance. On some sites these black spots have become almost entirely obliterated by being covered with drifting sand since the ground has been cleared, but the plough occasionally turns up the fire-burnt stones. They are all pre-Neutral.

These sites are scattered throughout the habitable territory, particularly in favoured positions on the shores of lakes and streams; and not only in localities where pine was the principal timber, but also where the trees were entirely deciduous, while the Neutral village sites, found in adjoining townships, are only in the pine lands. Usually there is only one spot at a place. A spot may be the remains of camp fires of a single lodge, or it may be a communal fire-place, the lodges having been grouped around it. Many of them appear to have been occupied for a long time, judging by the amount of discoloured soil.

No. 1. There are two lodge sites on the farm of John Schlemmer, lot 9, concession XIV. Here the late H. Z. Smith, of New Hamburg, found a number of chipped arrowheads.

No. 2. There is a lodge site on a low bank near a stream on the Klinkman farm, north half of lot 4, concession XIV. Here points chipped out of stone for arrows have been found.

No. 3. There are two lodge sites on the farm of Thomas Scott, lot 1, concession XIV. Here chipped stone points for arrows were the only artifacts discovered. A banner-stone was found on the Bell farm, on the south half of the same lot.

No. 4. There is a large lodge site on the bank of what was formerly a rivulet in one of Robert Woods' fields, lot 1, concession XIII, according to Mr. Woods. Here he has not found artifacts, probably because he is a recent tenant.

No. 5. There is a lodge site on the east bank of an affluent of Horner creek, on the farm of Robert Pettigrew, lot 4, concession XII. Here chipped stone points for arrows have been collected.

No. 6. There are three lodge sites on the bank of Horner creek on the farm of James Davidson, lot 10, concession XI. Here points for arrows chipped out of stone, and celts have been found.

No. 7. There are seven lodge sites on the north half of lot 4, concession X, and one in an adjoining field on lot 3. These are on the high bank of Horner creek. Here no artifacts have been found, although on the next farm to the east, chipped stone points for arrows, a gorget, and other artifacts have been secured. About 1901 a cache was found here containing thirty-seven chipped chert leaf-shaped forms with straight bases. None of these are over 2½ inches long. This cache is now in the Wintemberg collection catalogued under numbers 24331–24362 in the Provincial Museum, Toronto.

No. 8. There is a lodge site on the east bank of the river Thames, on the old Milburn farm, lot 11, concession X. From here no artifacts have been reported.

No. 9. There is a small lodge site near Horner creek, on lot 2, concession IX. This is only a few feet in diameter and was found by a son of Luke Gilholm while he was ploughing a new piece of land. Here the usual fire-burnt and cracked stones were seen. On the same farm chipped stone points for arrows and celts were found.

No. 10. There is a lodge site on the bank of the River Thames, on the farm of Joseph Gillespie, lot 9, concession IX. In the neighbourhood a few artifacts have been discovered. On the farm of James Nicol in the township of East Zorra, just south of this camp site, Mr. Nicol found chipped stone points for arrows, and an object like a thick gorget with two perforations which somewhat resembles a boat-shaped stone, but lacks the concavity of most of them and has a nipple on the convex side.

No. 11. There is a lodge site about one hundred rods west of Horner creek on the farm of John Cudmore, lot 4, concession VIII. From here no artifacts have been reported.

No. 12. There is a lodge site near Horner creek, on lot 2, concession VIII, according to John Mitchell, who lives on lot 3, concession VII. Here he found a bar amulet made of striped slate. It is 7 inches long, $\frac{5}{8}$ inch high, and $\frac{3}{4}$ inch wide. This specimen, which is now in the collection of D. A. Woods, of Toronto, is represented in the Victoria Memorial Museum by cast No. VIII-F-8307.

No. 13. There are several lodge sites on the farm of Frederick Mitchell, north half of lot 4, concession VII, as indicated by numerous fire-burnt stones and fragments of pottery. Here, a crude pottery pipe of a common type was found. The bowl is about $1\frac{1}{2}$ inches in diameter by 1 inch high; the stem is broken. It is now, catalogue number VIII-F-8303, in the Victoria Memorial Museum.

No. 14. There is a very large lodge site on the Isbister farm, on the northwest quarter of lot 7, concession VI. Here James Hewitt of Innerkip has found points chipped from stone for arrows, also celts, and pendants. Here a Mr. Bowman found a bowl broken from a pottery pipe, originally of nearly the same form as the one from site No. 13. This has been burnt to a deep black colour, and is decorated with incised lines. It is now in the J. Hewitt Collection at Innerkip.

No. 15. There is a lodge site on the farm of Edward Lock, lot 7, concession VI. From here no artifacts have been reported.

No. 16. There is a lodge site on the farm of Edmund Skillings, lot 7, concession VI, just east of site No. 15. Here were found many points chipped from chert for arrows, spears, and knives, several chipped stone points for drills, also celts, gorgets, four broken banner stones of the "butterfly" type, and a fragment of pottery. The fragment of pottery is unlike any found on near-by sites in having a cornice-like rim. It bears oblique incised lines. In both texture and decoration it is like pottery found on Neutral sites.

No. 17. There are five or six lodge sites along the bank of the river Thames on the McFarlane farm, lot 8, concession V. Here Mr. Hewitt has found chipped stone points for arrows, fragments of pottery, and other artifacts. On the farm of Daniel Brown, on the north half of this lot, about 1901, a pot, over 8 inches in diameter at the scalloped top and nearly 14 inches deep, was found under the roots of a pine stump. The decoration is confined to the rim and neck of the vessel. There are short oblique incised lines around the top, then a row of pits punched into the clay, next several marks encircling the neck, followed by a row of short vertical strokes and three encircling lines. Below these there is a chevron design bounded by another line which encircles the pot near its equator. The remaining surface is smooth except where traces of paddle marks remain. The specimen is now in the collection of F. Crocker of Stratford, Ontario.

No. 18. There is a lodge site on the farm of Samuel Trachsel, lot 4, concession V. Near this some artifacts have been discovered; a pottery pipe similar to the one found on site No. 13 is said to have been among them.

No. 19. There is a small lodge site on a newly broken piece of ground near the west shore of Cranberry lake, on the Joseph Chesney farm, lot 3, concession V.

No. 20. There are several lodge sites on the bank of a small stream, a few hundred rods east of Little Buck lake, on the farm of William Moyer, north half of lot 2, concession V. They are now indicated only by fire-burnt and broken stones, although when the land was ploughed several dark spots were plainly seen. Here J. Hewitt has found numerous chipped points for arrows, also fragments of pottery, drills, a small hammer stone, a heavy unsymmetrical grooved axe, and a slate pendant 5¼ inches long, by 2½ wide, with only one perforation and a number of notches on the lower edge. The hammer stone is made of granite, and appears to have been an angular fragment battered until it became nearly oval, save for a flat part of the original surface of the stone, which remains on one side. It still shows peck marks on its entire periphery. I found a chipping-block, or stithy, that is a stone with a deep hole in one side, and a number of fragments of pottery. Some of the potsherds found here are smooth; others arede corated with simple circular depressions arranged in a geometric pattern near the rim; and still others with equidistant parallel lines which may have encircled and covered the entire surface of the pot. A circular impression, possibly made with a hollow reed, forms the decoration on another fragment. Here Mr. Moyer found what appears to be an unfinished "woman's knife." This has been roughly chipped out of dark coloured slate, and is unusually large, being 12 inches long, 4½ wide, and about ¾ inch thick. It seems to be too thin to be a winged banner stone in process of manufacture. Here, also, was found a lizard-shaped amulet made of black slate. It is a little more than 4 inches long, 1 inch wide, and 1 inch thick. The lower side is flat and there are no perforations.

No. 21. There is said to be a lodge site on the Anthony Smith farm, lot 1, concession V. Its surface was obscured by sod at the time of my visit, but artifacts are said to have been numerous when it was first ploughed.

No. 22. There are several lodge sites on the bank of the small stream connecting Carter lake with the river Thames to the westward, on the farm of James B. McFarlane, lot 8, concession IV. Fragments of pottery were plentiful when the land was first ploughed. Here a clay pot was recently unearthed from a sand-bank and broken by two Indian boys of the neighbourhood. A fragment which I obtained from Mr. McFarlane showed the vessel to be of very inferior technique. Mr. McFarlane has also a piece of the rim decorated with round bosses made by punching from the inside of the vessel. Oblique incised lines along the edge below the rim complete the decoration of the top. Here points chipped from stone for arrows have been found.

No. 23. There are four lodge sites indicated by black spots near the river Thames on the farm of Charles Rapson, lot 9, concession IV.

No. 24. There are four lodge sites on the bank of a small stream on the farm of Charles Rapson, lot 10, concession IV. Here J. Hewitt has found chipped points of stone for arrows and other artifacts, while fragments of pottery are numerous.

No. 25. There is a site on the Scott farm, lot 10, concession IV, where none of the usual black spots indicating lodge sites were to be seen, but cultivation may develop them. Here J. Hewitt collected numerous points chipped from stone for arrows, fragments of pottery, and a broken gorget. Charles Edwards of Innerkip found a broken "butterfly"[1] banner stone a little over 2½ inches long. There are two deep notches cut on one side of the specimen which were possibly made after it was broken to fasten on the missing part. Points chipped from stone for arrows, also celts and fragments of pottery are found west of here on the W. P. Clarke farm, lot 11, concession IV.

No. 26. There are several lodge sites near what is locally known as the "Indian Spring" immediately south of Mud lake, according to E. M. Hersee, but fifty years of cultivation have obliterated nearly all traces of them. Here chipped points of stone for arrows and celts have been found.

BURIAL PLACES.

Four undoubtedly prehistoric burial places have been found in this township. All of these were near the lodge sites, which would seem to indicate that they belong to the sites. No artifacts were found in them.

No. 1. One modern burial accompanied by artifacts was found about 1876. The skeleton, which is of a female, with dolichocephalic skull, was discovered by Mr. Dickson on his farm, now the Murray place, on the north half of lot 2, concession XIV. With the remains were found a birch-bark needle case, a rusty knife, a piece of amethyst, and a brass kettle with a hole in the bottom, possibly made accidentally during the excavation rather than purposely to break it and make it useless to a grave robber (as was commonly done with kettles put in graves in other parts of Ontario, fifteen such kettles being found in an ossuary in Medonte township, Simcoe county, according to information from A. F. Hunter of Barrie). The skull and kettle passed into the possession of a local clergyman who afterwards presented them to the late W. S. Wilkinson, of Woodstock, and they are now in the collection of his son, Dr. W. M. Wilkinson, of Denver, Colorado.

No. 2. Two skeletons were dug out of a sandbank on lot 2, concession IX, by William Forman, during 1903. Their depth and orientation is unknown. Edwin Mitchell stated that the skeletons were about 8 feet apart and were flexed on the side. The nearly-formed wisdom teeth of one were not erupted. Dr. Dewar, of Bright, secured a fagment of a skull and Mr. Mitchell some other bones.

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[1] Cf. Fowke, Gerard, Stone Art, Fig. 145.

No. 3. On "Poverty Hill," on the lower half of lot 2, concession V, about 105 feet north of the concession line, I found the parietal of a skull protruding from a little wind blown hollow in the sand. About 10 feet of sand has been blown from above the skeleton, but most of this may have drifted over the original burial and, after the surface was disturbed by cultivation, again been blown away. William Mann, who lives about a fourth of a mile west of "Poverty Hill," says that when his father settled there he could not see the barn on Anthony Smith's farm to the east of the hill, although it was as high, or higher, than Mr. Mann's house; so the hill must have been at least 12 or more feet high in order to obscure the barn. The skeleton was found flexed and on its left side with head north and hands on the right cheek. Most of the ribs, some of the dorsal vertebræ, all the lumbar vertebræ, the pelvis, the upper ends of the femora, and the lower ends of the tibiæ were missing. The missing bones may have decayed, although the bones of the feet, which were on the same level, were intact. The tibiæ and the bones of the feet were only about 6 inches below the surface. Missing bones or other burials were not found although two of us dug here for several hours.

No. 4. On the hills to the south of this, in the next concession, there are a number of hollows possibly indicating graves. This burial ground is said to extend on to the old Murray farm, lot 3, concession IV, and on the farm of William Smith just east of the Murray place, lot 2, concession IV, a skeleton was unearthed from near the surface about 1896. Mr. Smith's employe found it. Further data were unobtainable.

No. 5. Several burials were found before 1876 on the old Hersee farm, lot 3, concession III, near the "Indian Spring."

Surface Finds.

Artifacts are frequently found on the surface unassociated with lodge sites or burial places. Points chipped from stone for arrows, knives, and spears, are commonly found throughout the township, while celts or adzes are not rare.

On the old Risk farm, lot 8, concession XIII, a gorget or pendant about 5 inches long, with one perforation, was found. On one side there are two conventionalized drawings of the human form. It is in the collection of James Skillings, living near Innerkip. On lot 6, concession X, points chipped from stone for arrows, and a gorget with one perforation, but with a sharp cutting edge at one end, were found by C. R. McCormick. The latter has been mutilated by use as a whetstone, and mislaid.

On the farm of James Edwards, lot 5, concession VIII, points chipped from stone have been found, also half of a winged banner stone made of brownish striped slate. It is of a common type, resembling fig. 169 in Boyle's "Notes on Primitive Man in Ontario," and is now in the collection of J. Hewitt, of Innerkip.

On the John Mitchell farm, lot 3, concession VII, there have been found points chipped from stone for arrows, spears, and knives, and fragments of a single pottery vessel from the high bank of Hagey lake.

On the Chesney farm, lot 7, concession V, many points chipped from stone for arrows, knives, and drills, also celts, and a keel-shaped limestone pipe-head have been found by his son George. This pipe is 2 inches long by 1¼ inches wide across the broad side, and about 1 inch thick. A rude geometric pattern appears on one side of this much weathered pipe.

On the Downey farm, lot 6, concession V, Mr. Downey found a well chipped knife of chert. A slate gorget and a pendant with one perforation, in the George Chesney collection, were also picked up on this farm.

On the Robert Small farm, lot 7, concession IV, fragments of pottery and a stone tube made of striped slate have been found. The tube is somewhat barrel-shaped, wider at one end than at the other, 2 inches long by about 1⅝ inches wide, and 1⅛ inches thick. It is in the collection of Charles Edwards, of Innerkip.

On the Biddis farm, lot 6, concession IV, a layer of stones, possibly a fire-place, is said to have been found while breaking new ground. Here chipped points of stone for arrows, and also other artifacts have been found.

On the north half of lot 4, concession IV, Amos Carter found a small limestone pipe similar to the one from the Chesney farm, a shallow mortar about a foot in diameter made of a roughly square piece of dark grey stone, and one or two pestles made of limestone. On the south half of this lot, on the Millar farm, many points chipped from stone for arrows, also the front half of an unfinished bird amulet and other artifacts have been found. This bird amulet is about 4⅛ inches long by 2½ inches high, and fully 1½ inches wide at the bottom. Only the lower portion of the neck has been polished, the rest of the surface still showing peck marks. On each side of the head there are projecting bosses evidently in process of transformation into large projecting eyes. It is in the Edwards collection at Innerkip.

On the William Mann farm, lot 3, concession IV, a gorget was found and recently many points chipped from stone for arrows and spears have been secured.

On George Tottle's farm, lot 1, concession IV, Mr. Tottle found a copper arrowhead, but as he has moved away, the specimen is not available.

On the north half of lot 1, concession IV, a long, roller-like pestle, celts, and points chipped from stone for arrows have been found by Robert Lockhart. The pestle is in the Burgess collection at Drumbo.

On the farm of Alexander Graham, lot 13, concession III, points chipped from stone for arrows, also celts, gorgets, and other artifacts have been found.

On lot 7, concession III, R. J. Baker found points chipped from stone for arrows, also celts and a small hatchet-shaped banner stone about 4 inches long, which is now in a private collection in Detroit.

Trails.

From the River Nith in Blenheim township, the next township to the east, a trail extended to the banks of Horner creek in this township and passed through the country about midway between the two concessions.[1] The course indicated on the accompanying map is presumably correct.

A trail, indicated approximately on the map, ran along the high hills, from the "Indian Spring" in lot 3, concession III, in a southwesterly direction, according to E. M. Hersee. Perhaps it connected with the Indian trail followed by the old stage road in East Oxford township to the south.

CONCLUSION.

The surface survey of this township, less than 13 miles long and barely 9 miles wide, an area much smaller than 100 square miles, resulted in the location in less than nine field-working days, counting earlier work as well as that for the Geological Survey, of twenty-six lodge and village sites, five burial places, and many surface finds. This makes a discovery of more than three sites per day. As there is no reason to consider this township exceptionally favourable for prehistoric occupation, it being in the midst of Ontario and not bordering a great lake or having a very large river, we may conclude that the other townships in the area common to southern Ontario, the cleared forest area, the St. Lawrence lowlands and the Iroquoian linguistic area, would average as productive. We may expect some to be more barren, but others, those located on lakes or including special features as quarries or rich corn land, to far surpass it. It thus seems that there is ample material in this area for archæological work.

The lodge sites are located on high land, ridges, or the edges of benches, but always near a spring or a stream. This indicates where we may expect to find sites in other parts of this area. Similar sites occur in Simcoe county[2] according to Hunter, and in the Niagara peninsula according to information from George Oliver of Jordan Station, Ontario. The lodge sites are circular, while some Neutral sites are oblong. The surface appearance of the sites resembles that of the Neutral sites of Blenheim township, but the finds and the location of the finds are different. They contain little or no ash, while Neutral sites are often largely made up of ash layers.

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[1] Wintemberg, W. J., "Archæology of Blenheim Township". (The Ontario Archæological Report for 1902, p. 69.)

[2] Hunter, A. F., "Huron Village Sites in Flos and Vespra townships, Simcoe county," Toronto, 1907, pp. 25, 34, 49.

Much of the pottery being similar to the Potomac-Chesapeake ware, seems to be of a type made by tribes of the Algonquian linguistic stock. These pre-Neutral sites, therefore, may have been of Algonquian occupation. All the sites found are prehistoric and pre-Neutral, the earliest period known in this general region, whereas in Blenheim township evidences were found of three distinct aboriginal periods—the pre-Neutral, the Neutral, and the European. They probably antedate not only Neutral but all Iroquoian sites in this part of the country and perhaps even in the whole of the Hurontario peninsula and parts of New York.

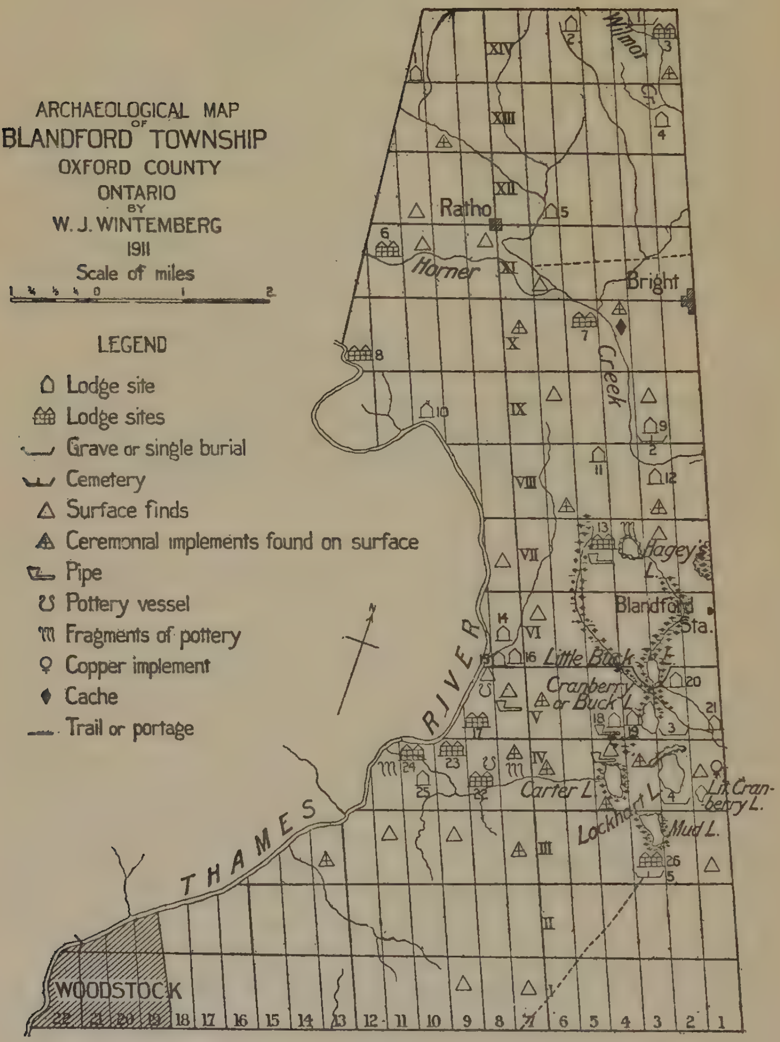
ARCHAEOLOGICAL MAP
OF
BLANDFORD TOWNSHIP
OXFORD COUNTY
ONTARIO
BY
W. J. WINTEMBERG
1911
Scale of miles
1 ¾ ½ ¼ 0 1 2
LEGEND
Lodge site
Lodge sites
Grave or single burial
Cemetery
Surface finds
Ceremonial implements found on surface
Pipe
Pottery vessel
Fragments of pottery
Copper implement
Cache
Trail or portage
Wilmot Cr.
Ratho
Horner
Bright
Creek
Hagey's L.
Blandford Sta.
Little Buck L.
Cranberry or Buck L.
Carter L.
Lockhart L.
Lit. Cranberry L.
Mud L.
THAMES RIVER
WOODSTOCK
XIV
XIII
XII
XI
X
IX
VIII
VII
VI
V
IV
III
II
I
22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

Fig. 5.